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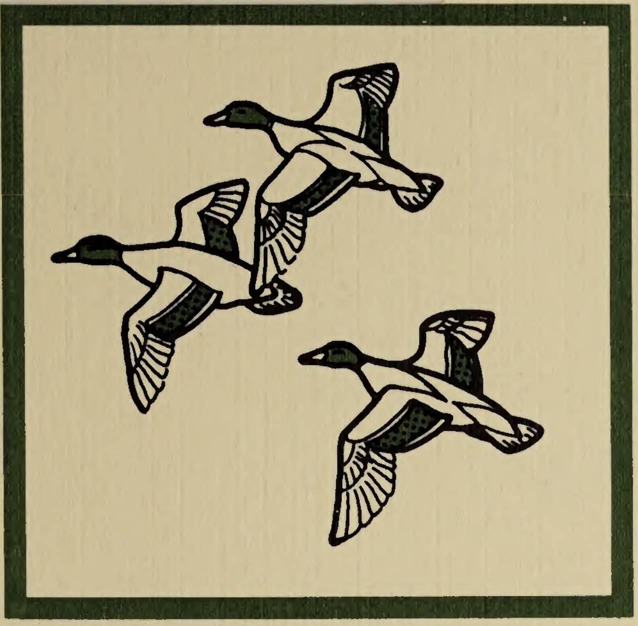
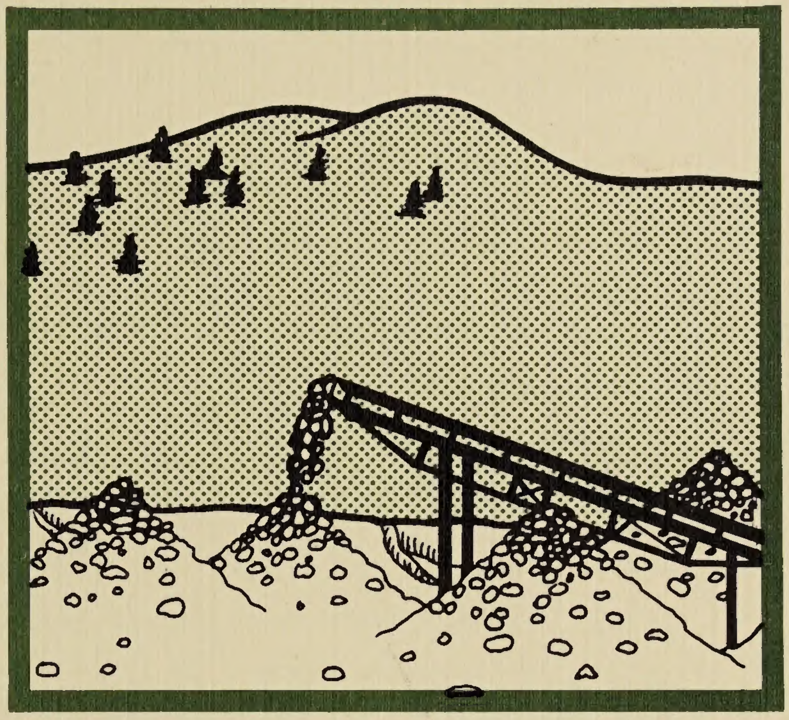
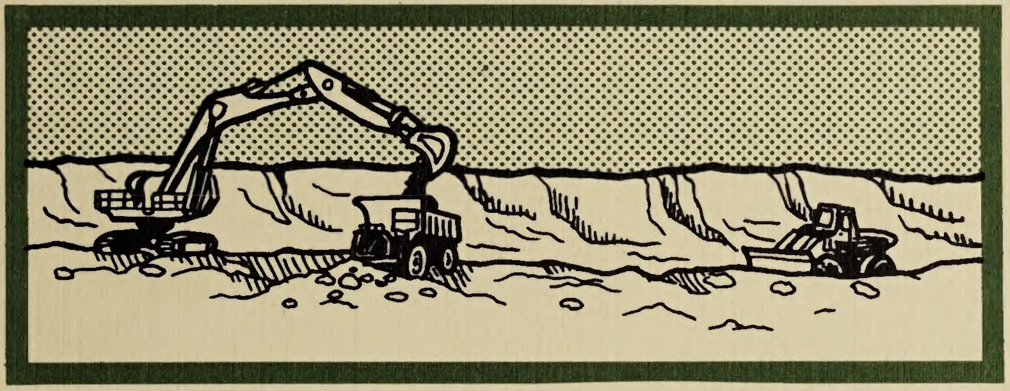
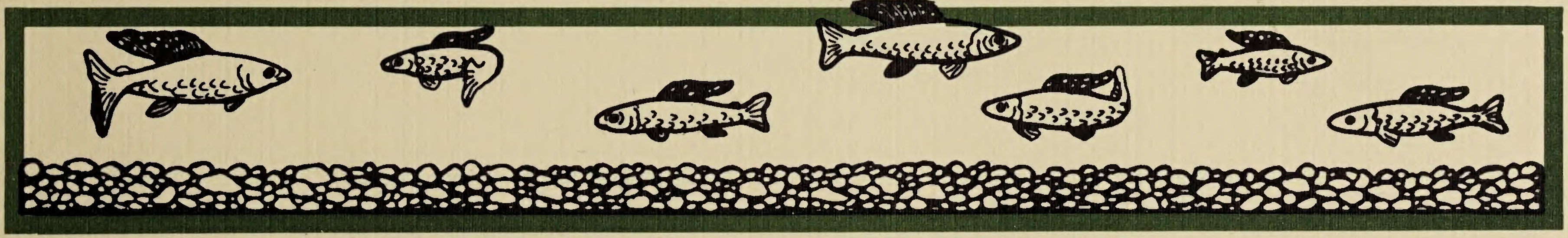


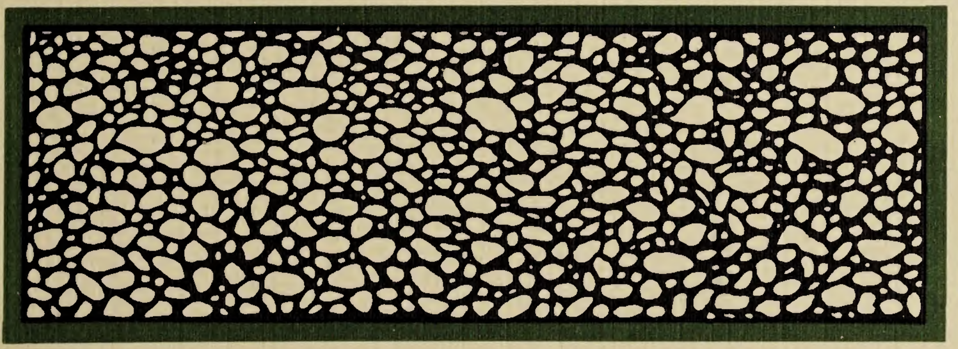
MINTO FLATS

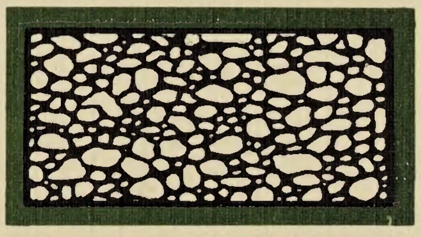
Placer Mining











DRAFT CUMULATIVE

ENVIRONMENTAL IMPACT STATEMENT

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ENVIRONMENTAL IMPACT STATEMENT
MINTO FLATS

Draft Cumulative (XX) Final ( )

ALASKA STATE OFFICE
ANCHORAGE, ALASKA

Lead Agency: U.S. Department of the Interior

Cooperating Agency: U.S. Army Corps of Engineers, Alaska District

Type of Action: Administrative (XX) Legislative ( )

ABSTRACT

This Draft Environmental Impact Statement assesses the cumulative or synergistic effect of placer mining on the Minto Flats watershed, especially subsistence uses and needs, as required by the U.S. District Court (District of Alaska) memorandum and order dated May 14, 1987, as amended, in Civil Case A86-083. A Proposed Action and two alternatives incorporating management options ranging from emphasizing regulation under 43 CFR 3809 to a "no mining" alternative as outlined by the Court are presented. The Proposed Action was selected to evaluate BLM's surface management practices in the affected watershed. The environmental consequences of all the alternatives are analyzed and presented.

For further information about this environmental impact statement, you may contact:

Michael J. Penfold
Attention: Richard Dworsky, Project Manager
Bureau of Land Management
Alaska State Office
701 C Street, Box 13
Anchorage, Alaska 99513
Telephone: (907) 271-3114

ITEM HAS BEEN DIGITIZED

March 3, 1849

United States Department of the Interior

TAKE PRIDE IN AMERICA

BUREAU OF LAND MANAGEMENT
ALASKA STATE OFFICE
701 C STREET, BOX 13
ANCHORAGE, ALASKA 99513-0099

3809 (918)

ITEM HAS BEEN DIGITIZED

Dear Reader:

Enclosed for your review is the Draft Environmental Impact Statement (DEIS) for the Minto Flats watershed. The U.S. District Court (District of Alaska) in civil case A86-083 filed on May 14, 1987, as amended, required BLM to prepare an EIS for Birch Creek watershed, and required an evaluation of the need for an EIS on the Fortymile, Minto Flats, and Beaver Creek watersheds.

The Bureau of Land Management (BLM) manages a substantial portion of the federally-owned land in Alaska that is open to mining activity. As a cooperating agency, the U.S. Army Corps of Engineers is the federal permitting agency for work involving the placement of dredged or fill material into waters of the United States, including wetlands.

Because placer mining activity has affected the water quality of several Alaskan streams, environmental organizations in Alaska are concerned that BLM procedures are inconsistent with its responsibility under the National Environmental Policy Act of 1969 (NEPA) to incorporate environmental reviews in decision- making procedures. These organizations also raised the question whether mining has an adverse effect on subsistence activity, and whether BLM permitting procedures are consistent with the Alaska National Interest Lands Conservation Act (ANILCA).

Specific to the Minto Flats watershed, the U.S. District Court required BLM to conduct a subsistence evaluation under ANILCA Section 810 and the follow up cumulative impact environmental analysis for the drainages within the Minto Flats watershed, and prepare corresponding documents.

At the present time, the COE does not have reclamation standards for placer mining, nor is it in the process of developing such standards. BLM analyzed the cumulative impacts of the restricted reclamation standards identified in Alternative A. The reclamation standards identified in Alternative A in this document are not ascribed to any specific agency.

Any person or group who has an interest in the findings of this Draft EIS may comment on it during the public comment period. The comment period begins the day the notice of filing is published in the Federal Register by the Environmental Protection Agency and ends 45 days later. Written comments may be submitted to: Richard Dworsky, Bureau of Land Management, 701 C Street, Box 13, Anchorage, Alaska 99513, by August 29, 1988 or through attendance at one of the hearings scheduled during the comment period. We will announce the times and places of the public hearings in the Federal Register and in local newspapers. Public meetings will be held in Anchorage, Fairbanks, and those rural villages in the area affected. They will comply with the requirements of Section 810 of ANILCA. You should retain this draft EIS because of the possibility that the Final EIS will be published in abbreviated form. If that occurs, you will need this document for reference.

Any change to this DEIS as a result of the public comment period will be made available for public review in the publication of the Final EIS.

I want to personally thank those of you who have contributed to and participated in the development of this Draft EIS. I hope your involvement will continue as we move forward into the formulation of the Final EIS in the coming months.

Lester K. Rosenkrance

Acting State Director

Notice of Public Meetings

The public comment period for the Minto Flats Placer Mining Draft Cumulative Environmental Impact Statement will be from July 11 through August 29, 1988.

Public meetings for this DEIS will be held at the locations below beginning at 7:00 pm. Subsistence hearings on the Minto Flats DEIS will immediately follow the public meetings.

Noel Wien Library
1215 Cowles
Fairbanks, Alaska
July 26, 1988

Bureau of Land Management Anchorage District Office
6881 Abbott Loop Road
Anchorage, Alaska
July 27, 1988

State of Alaska
Department of Transportation Bldg.
Livengood, Alaska
August 9, 1988

Lakeview Lodge
Minto, Alaska
August 10, 1988

The public meetings in Anchorage and Fairbanks will also provide the opportunity for making comments on the previously released Fortymile River DEIS.

Written comments will be accepted at the address below through August 29, 1988:

Minto Flats EIS
c/o Richard Dworsky
Bureau of Land Management
701 C Street
Box 13
Anchorage, Alaska 99513

Summary

Introduction

A United States District Court for the District of Alaska Memorandum and Order (A86-083 Civil) filed on May 14, 1987, instructed the Bureau of Land Management (BLM) to cease approving Plans of Operations for federal placer mines after October 1, 1987, in the Birch Creek watershed, pending completion of an adequate cumulative effects Environmental Impact Statement (EIS). On May 28, 1987, additional injunctions followed covering the watersheds of Beaver Creek, the Fortymile River, and Minto Flats (which is comprised of the Chatanika River, Tolovana River, and Goldstream Creek). On July 22, 1987, the Court issued an amendment to the May 14 and May 28 orders, extending the date of cessation to the November 15, 1987. The term "lawsuit" hereafter refers to the above orders and injunctions.

This draft EIS analyzes the cumulative environmental impacts of placer mining and assesses the effects of such mining on subsistence uses on the Minto Flats watershed, as directed by the District Court in the lawsuit.

There are two primary objectives of this EIS. The first is to identify and consider performance standards under which placer mining may be conducted on federal lands in the area. The second is to comply with the Court Orders and to conduct evaluations and prepare the associated documents under the National Environmental Policy Act (NEPA) and subsistence requirements found in Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA).

At issue are the cumulative impacts of multiple mining operations on the environment. Initially under these injunctions, only Plans of Operations on federal claims were affected. Mines operating under Notices (operations disturbing five acres or less) were not affected; however, the impacts of such mines must be included in the evaluations. A subsequent Court Order of November 6, 1987, requires Plans of Operation for all operations regardless of size, on land withdrawn from mineral entries, with a one-year exception for those mines operating in 1987.

This EIS will be the overarching environmental document from which more site-specific environmental assessments can be tiered. Tiering is an interrelationship in which reference to a more general NEPA document such as this EIS can be made in a more specific one, thus avoiding duplication. A more specific environmental assessment will not change or modify decisions resulting from this analysis, but will, on a case-by-case basis, identify more detailed and site-specific actions and mitigation measures to reduce environmental impacts.

Fireweed

The figure below illustrates some of the different guidelines and responsibilities of BLM, other federal agencies, and the State of Alaska in managing placer mining on the public lands.

Agency	Legal Guidelines & Plans for Management	Responsibility of Agency	Enforcement Responsibility of Agency
BLM	Resource Management Plan 43 CFR 3809 regulations	Surface management	Due and neccessary mining action
EPA	Section 401 of Clean Water Act	Water quality	Water standards
COE	Section 404 of Clean Water Act	Dredge and fill in waters and wetlands	Terms and conditions of COE permits
State of Alaska	Clean Water Act State regulations	Water quality Anadromous fish	State standards

General responsibilities of applicable agencies concerning placer mining. This table applies to State, Federal and private mines. BLM evaluates the cumulative impacts of all mines, but can only manage within its jurisidiction.

BLM manages mining under the General Mining Law of 1872, 30 U.S.C. 22 et seq., as amended, and the Federal Land Policy and Management Act (FLPMA) of 1976, 43 U.S.C. 1701 et seq. The 1872 Mining Law provides for the exploration, development, production, and purchase of mineral resources of the public lands, as well as the implied right of statutory access to mining claims.

The Minto Flats watershed is located directly north and west of Fairbanks and encompasses nearly 2.2 million acres of land. A map entitled "Area Map" depicting major features, one entitled "Status" showing land status, and the "Tributaries and Main Physical Features Map" showing topography can be found in Chapter One.

As required by NEPA regulations, BLM used an open process to gather public input. To this end, a Notice of Intent to prepare environmental impact statements was published in the Federal Register on August 18, 1987, and in local newspapers in late August 1987. BLM also conducted a series of public, or "scoping" meetings in locations throughout the affected area between July and September 1987. At the same time, more than 450 notices of the public meetings were sent out to miners, environmentalists, native groups, and other members of the public.

The BLM also invited participation from other government agencies, private organizations, the placer mining industry, and any other concerned individuals. At the scoping meetings a description of the EIS process and the proposed activity was provided by the appropriate BLM District Managers. The meetings were then opened to members of the public to voice their concerns and ask any questions about the issues.

Significant issues include:

- What are the impacts of placer mining operations on water quality?
- How are water quality standards regulated and enforced, and who performs this function?
- What are the impacts of placer mining on terrestrial habitats?
- Have reclamation practices and improved management under the 43 CFR 3809 regulations occurred since 1981?
- What are the impacts of other agency laws and regulations on the placer mining industry?
- What are the impacts of placer mining on subsistence activities ongoing in the region?

Specific coordination meetings were held with various State of Alaska agencies including the Department of Natural Resources, Department of Environmental Conservation (ADEC), Department of Fish and Game, and the Office of Management and Budget, Office of the Governor. Meetings were also held with the following federal agencies: Environmental Protection Agency (EPA), Army Corps of Engineers (COE), National Park Service, and Fish and Wildlife Service.

After the public comment period following the release of this document, a management decision will be made which incorporates and addresses the comments. This management decision will be included in the Record of Decision and responses to the comments will be addressed in the Final EIS.

PHOTO. TAKEN AT MIDNI

Midnight celebration at Chatanika, Alaska, July 4, 1910. From the Lulu Fairbanks collection, courtesy of the Alaska and Polar Regions Department Archives, University of Alaska, Fairbanks.

Summary of Alternatives and Environmental Consequences

Under all of the land management alternatives described in this EIS, BLM would manage lands under its authority to meet requirements found at 43 CFR 3809 (surface management regulations). Regulations of the COE are found at 33 CFR 320 et seq. The descriptions for each alternative will evaluate the cumulative impacts under various administrative conditions and requirements of not only the BLM but also those of the State of Alaska, EPA, and the COE.

Proposed Action

The Proposed Action for this EIS is to continue management of mining claims on federal lands as it was conducted during the summer of 1987. Mining activities under the Proposed Action would be similar to the activity that occurred during the 1987 mining season. BLM would manage placer mining in the Minto Flats watershed according to State of Alaska water quality standards with EPA variances. Reclamation activities would reshape tailings to approximate the surrounding physiography and spread the overburden and available topsoil over the reshaped tailings. Settling ponds would be similarly reclaimed. The stream bypass would be stabilized or reinforced to make it the permanent channel. The reclaimed site would be allowed to revegetate naturally.

The water quality performance standards would be the current EPA effluent guidelines and ADEC water quality standards, or the existing EPA/ADEC variance for the operation. The performance standards are 0.2 ml/l of settleable solids and 5 Nephelometric Turbidity Units (NTU) above natural conditions when natural turbidity is 50 NTU or less, and not more than a 10% increase in the turbidity when the natural turbidity is 50 NTU, not to exceed a maximum increase of 25 NTU at the mine effluent discharge point.

Consequences

Under the Proposed action, BLM reasonably foresees that a total of 37 mines (12 federal and 25 State and private mines) would be operating continuously for the next ten years in the Minto Flats watershed.

There should be no significant cumulative impacts on mineral resources.

The soil profile would be completely altered by mining operations on approximately 851 acres of ground.

Increased levels of turbidity would occur on all actively mined streams. The discharge of particulates from active mines may make a significant contribution to water quality deterioration in the watershed, particularly Goldstream Creek. The contribution of sediment from non-point sources is unknown and cannot be adequately quantified with existing data, but it is not expected to be significant. The estimated sediment load from the watershed due to erosion and non-point sources is 13,070 tons per day.

The vegetation cover would be destroyed in the areas of the mines and roads, resulting in an unavoidable short-term loss of productivity. Approximately 136 acres would regrow to a riparian tall shrub community within 30 years of reclamation, and an additional 64 acres would regrow within 50 years on mining disturbance in creek bottoms. New mining disturbance on 651 acres would remain barren or sparsely vegetated. This acreage would be an irretrievable and irreversible loss of vegetation resources.

There are no "listed" or "candidate" threatened or endangered plant species within the watershed, nor are there any endemic species.

Approximately 5,240 acres of wildlife habitat would be physically altered due to mining and related activities. Periodic disturbances to wildlife due to the operation of vehicles and machinery, and human habitation affecting 56,670 acres could result in a low to moderate level of short-term cumulative effects. The principal long-term adverse effect of new mining would be the unavoidable loss of approximately 761 acres of upland riparian habitat in the upper Chatanika, upper Goldstream/Cleary Summit, and upper Tolovana/Livengood areas for a 30 to 50-year period. The long-term cumulative loss of habitat to federal (191 acres) and State and private (460 acres) mining activities in these areas would probably contribute to a slight reduction in moose population potential. The potential exists for a long-term cumulative adverse effect to wildlife if human use of the area increases greatly in crucial wildlife habitats.

The peregrine falcon is the only threatened or endangered species present within the watershed. Protective measures would be required for any mining activity within one mile of these nests. No anticipated activities are within one mile of any known nest areas.

Physical alteration of streams and increases in suspended sediment from mines in the basin would result in adverse cumulative effects on the aquatic resources. Streams that are blocked to fish passage would also be unavailable as habitat to some fish populations in the affected area. The overall cumulative effect of total suspended sediment and turbidity increases in the Minto Flats watershed cannot be determined. Fishery resources would remain similar to those present in 1987. The Tolovana and Chatanika Rivers would continue to support numerous fish species and key habitat, while the poor fish habitat and low fish populations would continue in upper Goldstream Creek.

Cumulative impacts on cultural resources in the Minto Flats watershed do not appear to be significant.

Present village-based subsistence usage of the Minto Flats area is downstream from mining activity on BLM lands, and is done principally by residents of Minto village. As shown on the subsistence use area map (Subsistence Use Map, Chapter Three), overall traditional subsistence use of the Minto Flats area by Minto village residents extends northeast to near Livengood, southward to beyond the Chatanika River, and then westward along the Tanana River to beyond its confluence with the Tolovana River. Thus, the past, current, or potential impacts to subsistence users and resources from mining are indirect to Minto village, and would involve events upstream from where village- based subsistence users usually go for harvesting resources at the present time. Currently, there is evidence that certain customarily used riverine and lake navigational access routes in the

Minto Flats area near Minto village have been obstructed to some degree by sedimentation that came in part from historic upriver mining areas. Consequently, a significant restriction to subsistence uses has developed in such areas and is occurring today, with past and present mining involved in causing it to some greater or lesser degree. However, mining in 1987 on federal claims appears not to have notably further added to this sedimentation and thus to the ongoing restriction to subsistence uses. With mining under the Proposed Action, downstream subsistence uses still would be significantly restricted, but due primarily to ongoing sediment redeposition and no reclamation standards on non-federal lands. This cumulative significant restriction would continue for several years even if all mining ceased immediately in the Minto Flats watershed because certain now-sedimented areas are likely to remain so for the foreseeable future. As to the potential for other mining-related impacts to subsistence uses, none are thought likely. This includes consideration for potential future increased mining-related access, which, if it occurs, would not cross the portions of the Minto Flats area used by the Minto villagers for subsistence purposes.

Placer mining impacts to fish and wildlife habitat and populations may affect the quality of hunting, fishing, and wildlife viewing opportunities. Additional access roads would also provide for increased recreation in the watershed; however, these roads would impact the visual resources.

Mining expenditures, total output, mining employment, employment effect, mining income, and total income would increase by about 23%. Annual costs for all federal mining operations would be $62,400 for water treatment and $24,000 for reclamation. Administration and enforcement of the Surface Mining program for placer mining would cost the BLM about $21,600 (all values are in 1987 dollars).

Typical mining operation showing river tailings. Courtesy of Bureau of Land Management.

Figure 2-6 is a summary of the estimated unit costs for federal mines associated with the implementation of each alternative. Costs for State and private mines were not estimated because BLM has no regulatory authority for these operations; however, water treatment costs would probably be similar to the costs for federal mines. No reclamation would be required for State and private mines.

Alternative A

This alternative would focus on various standards or procedures proposed or under discussion by the EPA and other agencies. The water quality performance standards for this alternative would be zero ml/l settleable solids and zero NTU turbidity above natural conditions. Reclamation standards would emphasize restoration of naturally appearing contours, creek channels, and native vegetation. Mining activities would be conducted to minimize impacts to wetlands and riparian zones.

Consequences

The effects of Alternative A are based on 27 mines (9 federal and 18 State and private mines) operating continuously for the next ten years.

There should be no significant cumulative impacts on topography or mineral resources. The soil profile would be completely altered by mining operations on approximately 621 acres of ground. The following discusses the significant difference between this alternative and the Proposed Action.

There would be no direct impact on water quality from mining operations; however, it is likely that occasional high water or failure of settling ponds would introduce collected sediments into the stream channel. The sediment load from the watershed due to erosion and non-point sources would be 13,128 tons per day.

The vegetation cover would be destroyed in the areas of the mines and roads, resulting in an unavoidable short-term loss of productivity. A riparian tall shrub community would regrow on 144 acres within 25 years of reclamation, and an additional 113 acres would regrow within 50 years on mining disturbance in creek bottoms. New mining disturbance would cause 364 acres to remain barren or sparsely vegetated. This acreage would be an irretrievable and irreversible loss of vegetation resources.

Approximately 4,887 acres of wildlife habitat would be physically altered due to mining and related activities. Periodic disturbances to wildlife due to the operation of vehicles and machinery, and human habitation affecting 46,486 acres could result in a low to moderate level of short-term effects. The principal long-term adverse effect of new mining would be the unavoidable loss of approximately 818 acres of upland riparian habitat for a 25 to 50-year period. The long-term cumulative loss of habitat to federal (122 acres), and State and private (343 acres) mining activities in these areas would probably contribute to a slight reduction in moose population potential.

Impacts to fishery resources would be less than those discussed in the Proposed Action. The reduction in impacts would probably be most notable in the Goldstream Creek drainage; however, the extent of fishery resource recovery cannot be determined.

A significant restriction to subsistence uses would still remain in the Minto Flats area until the cumulative effects of past sedimentation are substantially reversed. Whether or not this is possible is uncertain since the Minto Flats area is a natural sediment trap and once sediment is deposited it may be there indefinitely. In the short term, the impacts on subsistence uses and resources would be similar to those under the Proposed Action, although some short-term fish and wildlife productivity gains might occur. This is because reclamation standards would be required on non-federal lands as well as federal lands, this potentially decreasing sedimentation entering riverine areas.

Impacts to recreation opportunities would be less than those anticipated in the Proposed Action.

Visual resources would be impacted the least in this alternative due to reclamation at all mine sites.

Mining expenditures, total output, mining employment, employment effect, mining income, and total income would decrease by about 10%.

Annual costs for all federal mining operations would be $423,000 for water treatment and $30,000 for reclamation. Administrative and enforcement costs to the BLM and the COE would be approximately $23,400 (all values in 1987 dollars). Costs for State and private mines were not estimated because BLM has no regulatory authority for these operations; however, water treatment and reclamation costs would probably be similar to the costs for federal mines.

Alternative B

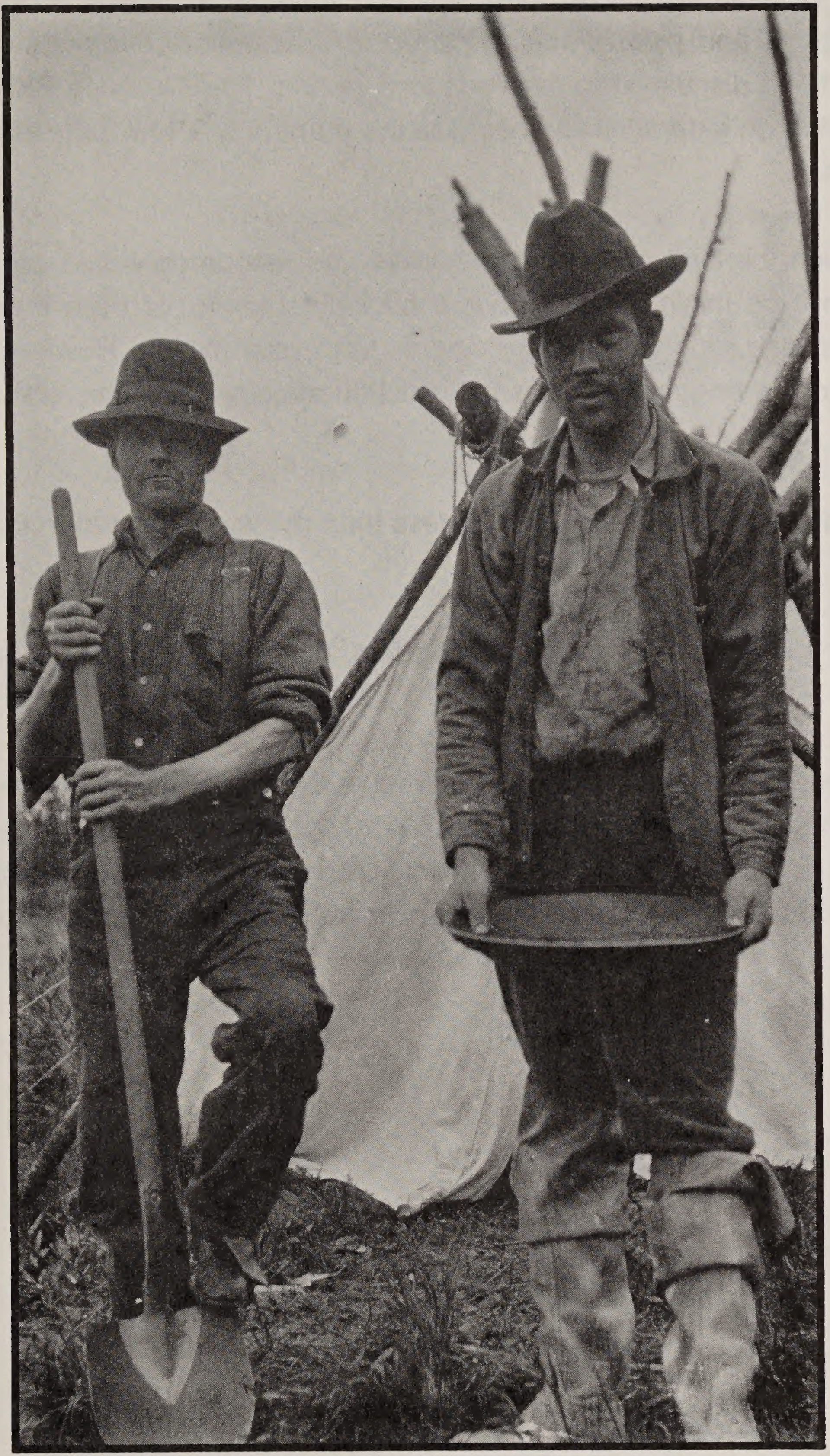
This is the "no mining" alternative defined by the District Court in its Memorandum and Order of May 28, 1987, as amended. Under this alternative, no applications for mining claims, under either Plans of Operations or Notices, would be processed or approved by the BLM. Validity examinations would be conducted for each properly recorded federal mining claim, appraisals made, and the owner would be compensated accordingly. Stabilization of surface disturbance which has occurred since January 1, 1981 would be required on all federal claims, and restoration would be allowed to proceed by natural processes.

This action violates current regulations (43 CFR 2091.1 for accepting applications and 43 CFR 3809.1-6 for processing applications) and would therefore require changes in the regulations for legal implementation.

The State of Alaska or various Native corporations have top-filed most of the federal mining claims in the watershed. If Alternative B were to be adopted, these lands would eventually be conveyed to the appropriate entity, leaving little to no lands under BLM jurisdiction in the watershed.

Consequences

The effects of Alternative B are based on 25 State and private mines operating continuously for the next ten years. There would be no further placer mining on federal claims. The following discussed the significant differences between this alternative and Alternative A.



Alaska placer miners circa 1928 or 1929. Photo courtesy of the Anchorage Museum of History and Art.

Cessation of mining on federal claims would end further short- and long-term impingements upon topography of the public lands.

Gold resources would remain undeveloped on these lands.

Mining on non-federal lands would disturb the soil profile on 574 acres.

The impact of placer mining on water quality would be less than that described in the Proposed Action. The estimated sediment load from the watershed due to erosion and non-point sources would be 13,123 tons per day.

The vegetation cover destroyed on areas previously mined would result in a long-term unavoidable loss of over 3,640 acres of vegetation resources in the area from historic mines and roads. Activity on State and private lands would result in 72 acres of tall shrub community regrowing within 30 to 50 years, an additional 43 acres regrown to shrub in 50 years, and 460 acres would remain barren or sparsely vegetated.

Approximately 4,600 acres of upland riparian wildlife habitat would remain physically altered because of past mining-related activities. Continued mining on State and private lands would result in the physical alteration of 575 acres. Periodic disturbances to wildlife due to the operation of mining vehicles, machinery, and human habitation at State and private mines would result in 42,814 acres subject to short-term adverse effects in localized areas during the mining season. The principal long-term effect of past federal mining would be the unavoidable loss of approximately 3,750 acres for over 50 years. The long-term cumulative loss of habitat to mining activities in these areas would probably contribute to a slight reduction in moose population potential.

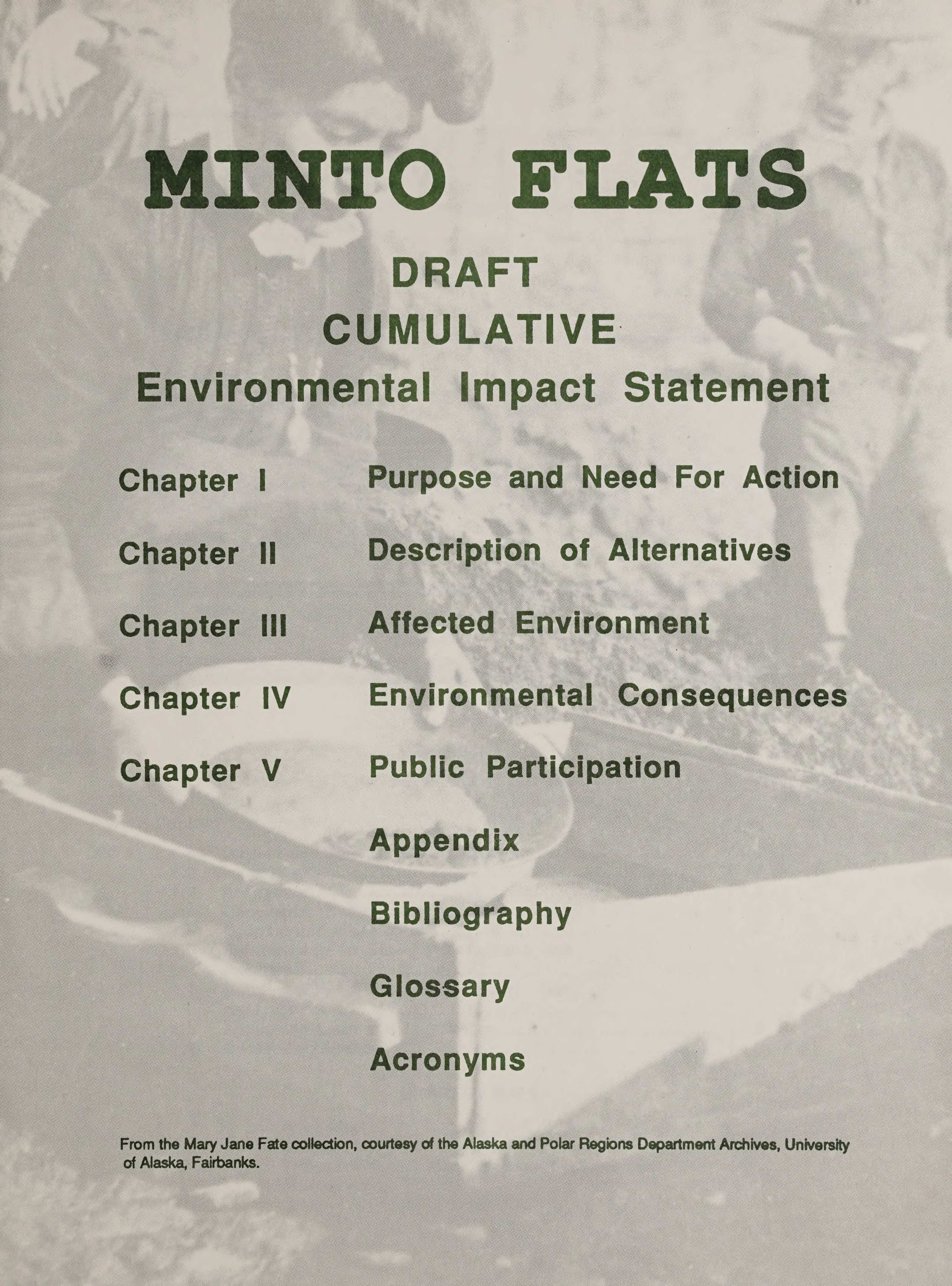
The overall cumulative adverse effect of total suspended sediment and turbidity increases in the Minto Flats watershed attributable to State and private mining cannot be determined. Impacts to fishery resources would be less than those discussed in the Proposed Action. The Tolovana River would be impacted the least by no mining on federal claims because there are only a few State and private mines projected in this drainage.

As described under the Proposed Action, certain subsistence activities and resources would continue to be significantly restricted even if no mining were to occur on federal lands, or even if no mining occurred at all in the entire drainage, due to ongoing impacts from past mining. However, this alternative would not add further to the ongoing significant restriction already occurring in the area.

Impacts to recreation opportunities and visual resources would be less than those anticipated in the Proposed Action.

Mining expenditures, total output, mining employment, employment effect, mining income, and total income would decrease by about 17%.

Under the no-mining alternative, the federal Government would be required to provide compensation for condemning valid federal mining claims. The present net value of the claims is roughly estimated to be between $42,000,000 and $117,250,000. Validity examinations on all properly recorded federal mining claims within the watershed would cost the BLM approximately $700,000 to complete (all values in 1987 dollars).



MINTO FLATS

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Environmental Impact Statement

Chapter I Purpose and Need For Action

Chapter II Description of Alternatives

Chapter III Affected Environment

Chapter IV Environmental Consequences

Chapter V Public Participation

Appendix

Bibliography

Glossary

Acronyms

From the Mary Jane Fate collection, courtesy of the Alaska and Polar Regions Department Archives, University of Alaska, Fairbanks.

MINTO FLATS

Chapter I
Purpose and Need for Action

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CHAPTER MAPS

Area Map
Status Map
Tributaries and Main Physical Features Map

1.1 Purpose and Need

There are two primary objectives of this Environmental Impact Statement (EIS). The first is to identify and consider performance standards under which placer mining may be conducted on federal lands in the area, including methods and procedures which will be utilized "...when an activity is being accomplished by a prudent operator in usual, customary, and proficient operations of similar character and taking into consideration the effects of operations on other resources and land uses, including those resources and uses outside the area of operations" (43 CFR 3809.0-5(k)). Figure 1-1 identifies the directives from the various court orders and injunctions pertaining to this placer mining EIS, and the products of the EIS process which respond to these directives. The second objective is to comply with the Court Orders (described in Section 1.2) to conduct evaluations and prepare the associated documents under the Alaska National Interest Lands Conservation Act (ANILCA) subsistence requirements (ANILCA Section 810) and the National Environmental Policy Act (NEPA).

COURT DIRECTIVES	EIS PRODUCTS
1. Identify the degree of environmental harm (and benefits-added by team).	• Assess cumulative impacts • Consultant studies - e.g. water, fish, and wildlife • Chapter 4
2. Identify the extent that environmental harm can be prevented.	• Identification of alternative actions identified in Chapter 2 and evaluated in Chapter 4 • Record of decision • Management under 3809 program model • EA consultant contract
3. Identify the expense of preventing some or all of the harm.	• Economic study • Chapters 2 and 4 and the Appendix
4. Identify the economic and social benefits and costs of the matter being evaluated.	• Economic study • Subsistence evaluation • Chapter 4
5. Assess cumulative environmental impacts of water quality and subsistence.	• Consultant studies including water quality, fish, and aquatic habitats, visual study and subsistence • Chapters 2 and 4

Figure 1-1. Directives of the District Court Memorandum and the products of the EIS in response.

The original court injunction (A86-083 Civil) requires the Bureau of Land Management (BLM) to comply with ANILCA 810 regarding the cumulative effects of placer mining on subsistence use and access in Minto Flats. On the surface, it would appear that completing a subsistence evaluation and holding a formal ANILCA 810 hearing would comply with the injunction. However, after the scoping meetings and a review of data and literature, BLM elected to complete a full EIS rather than an Environmental Assessment (EA) for the following reasons:

1. **Controversy.** The Council on Environmental Quality (CEQ) regulations (40 CFR 1508.27) require an agency to consider if the effects of an action on the human environment are likely to be highly controversial. The issue of the effects of placer mining on access and wildlife/fisheries habitats in the Minto Flats is a controversial one. There are widely differing opinions among placer miners, environmental groups, sport hunters, rural residents, and researchers about the impacts and their magnitude.

2. **Definitions of "cumulative effects" and "subsistence.** "Cumulative effects" include the impacts from historic, current, and projected future actions. "Subsistence" includes the access to resources, as well as the resources themselves. Scoping and further research indicate that historic hydraulic placer mining, especially in Goldstream Creek and the Chatanika River, has washed overburden downstream into the eastern portion of Minto Flats. These silt deposits have contributed to the changes in drainage patterns of the streams and Minto Lake, changing hisoric access patterns to these areas. Therefore, although the impacts are from the past, and current levels of mining do not seem to be making appreciable contributions to the deposition of silts in Minto Flats, the cumulative impacts of placer mining have had a significant impact on subsistence access, thus triggering an EIS.

3. **Tiering for BLM Plans of Operations.** This EIS will serve as an overarching document for EAs written to review and consider approval of Plans of Operations for placer mines in the watershed.

1.2 Introduction

The Court Memorandum and Order filed on May 14, 1987, instructed BLM to cease approving Plans of Operations for federal placer mines in the Birch Creek watershed after October 1, 1987, pending completion of an adequate cumulative effects Environmental Impact Statement (EIS). On May 28, 1987, injunctions followed which covered the watersheds of Birch Creek, Beaver Creek, the Fortymile River, and Minto Flats (which is comprised of the Chatanika River, Tolovana River, and Goldstream Creek). On July 22, 1987, the Court issued an amendment to the May 14 and May 28 orders, extending the date of cessation to November 15, 1987. The term "lawsuit" hereafter refers to the above orders and injunctions.

At issue for BLM are the impacts of multiple mining operations on the environment, including the cumulative impacts, especially on water quality, visual, and subsistence resources. Initially, under these injunctions, only Plans of Operation on federal claims were affected. For the U.S. Army Corps of Engineers (COE), the principle issues involve avoiding or minimizing impacts to waters and wetlands. Mines operating under Notices (those disturbing five acres or less) were not affected; however, the impacts of such mines are included in this EIS. A subsequent court order of November 6, 1987, requires Plans of Operations for all operations on claims with valid existing rights, regardless of size, on land withdrawn from mineral entry, with a one-year exception for mines which operated in 1987.

An EIS describes, for public review and consideration, a proposed federal action that could significantly affect the human environment. In this case, the Court felt that cumulative environmental impacts for all placer mining, on State and private, as well as federal lands, should be addressed, rather than the current practice of completing an environmental review of individual mining Plans of Operation.

This EIS is based on NEPA and CEQ regulations. Per CEQ regulations, BLM used an interdisciplinary team in a systematic approach to analyze the affected area, to estimate the environmental effects, and to write this statement. Where data gaps appeared, the BLM used contract services to collect and analyze additional information. The contractors included the State of Alaska and private consulting firms. A list of the consultant contracts is included in Appendix A-1. A list of the EIS preparers is included in Chapter Five.

This EIS is not a decision document meant to change the land use classifications established by other agencies. BLM does not have a land use plan for the Minto Flats watershed. A Record of Decision will define the overarching terms and conditions under which placer mining may be conducted under 43 CFR 3509.

These regulations require preparation of at least an EA for the approval of a placer mine Plan of Operations. These EA's will tier off this EIS. Tiering is an interrelationship in which reference to a more general NEPA document such as this EIS can be made in a more specific one, thus avoiding duplication. No Plans of Operations will be approved based solely on this EIS. Also, a more specific environmental assessment will not change or modify decisions resulting from this analysis, but will, on a case-by- case basis, identify more detailed and site-specific actions and mitigation measures to reduce environmental impacts. Tiering can also be used by other agencies, such as the COE. The COE may use this EIS as a generalized document for reviewing work in the watershed under the Alaska COE regulatory program relative to Section 404 of the Clean Water Act.

During 1987, approximately 30 mines were active in the drainages of the Minto Flats watershed. However, additional mining operations on the federal, State, and private mining estate are anticipated within the next ten years. This document analyzes the cumulative impacts of these anticipated future mining activities.

1.3 Background

BLM manages mining under the General Mining Law of 1872, 30 USC 22 et seq, as amended, and the Federal Land Policy and Management Act (FLPMA) of 1976, 43 USC 1701, et seq. The 1872 Mining Law provides for the exploration, development, production, and purchase of mineral resources on public lands, as well as the implied or statutory right of access to mining claims.

FLPMA provides that, in managing the public lands, the Secretary of Interior shall take any action required to prevent "unnecessary and undue" degradation of the land. This FLPMA provision is implemented by the Code of Federal Regulations (CFR) section covering surface management (43 CFR 3809).

The Clean Water Act, Section 404, applies to the placement of dredged and/or fill material into waters of the United States, including wetlands. Regulations of Section 404 for the COE are at 33 CFR 320 et seq. Procedures for implementing NEPA for COE are at 33 CFR 230 and 325.

The crux of the present concern is the nature, degree, and extent of the cumulative impacts of mining and related activities on the physical, biological, and socio-economic environment in the four watersheds the Court identified. In particular, the cumulative effects and impacts of placer mining need to be clearly explained and fully analyzed. The CEQ regulations at 40 CFR 1508.7 define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time."

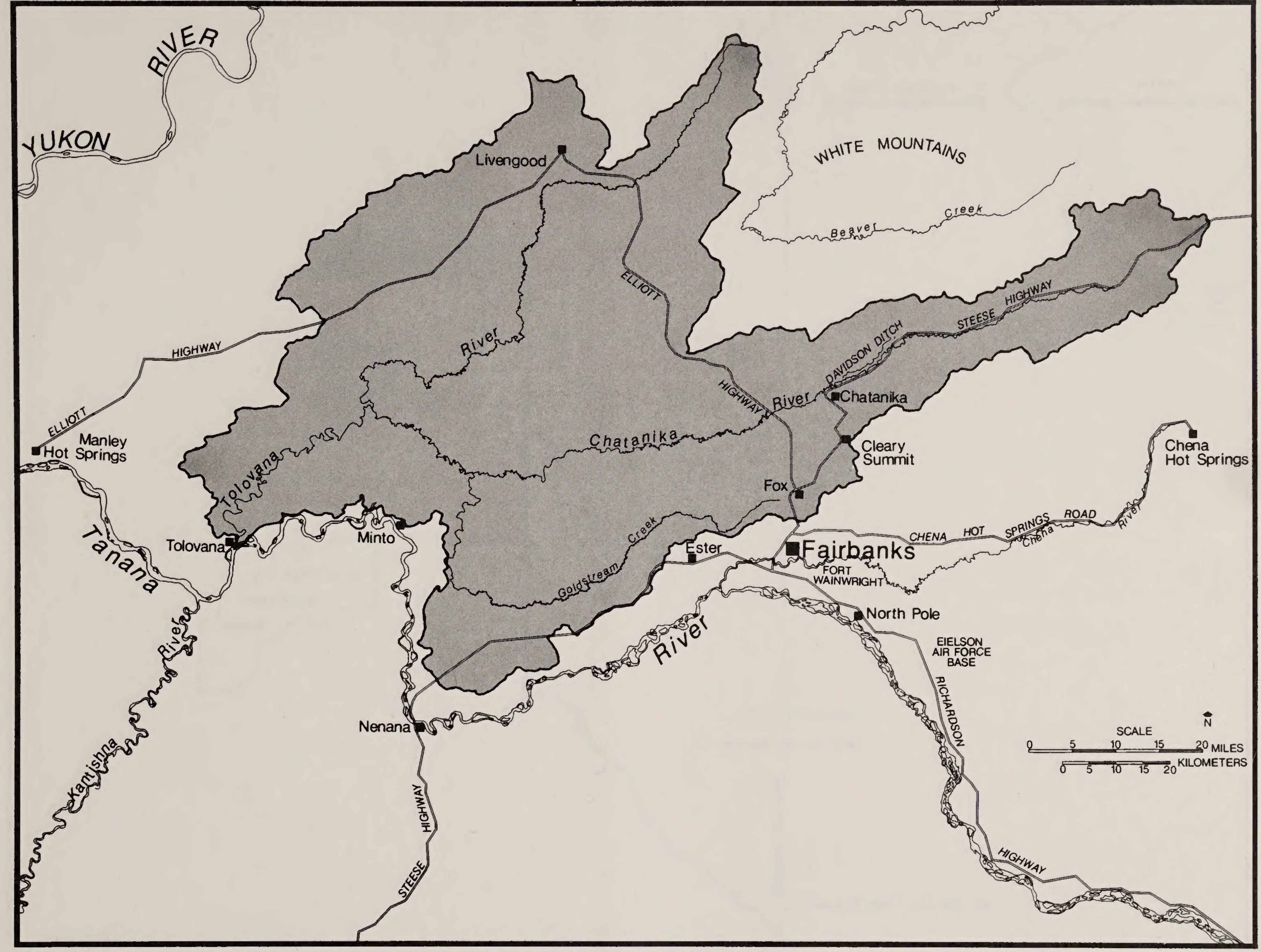
Because of uncertainty surrounding the number of mines that may operate in the reasonably foreseeable future, a methodology was established by forecasting the price of gold in the future and the number of mines that BLM might expect to operate in the next ten years (Appendix B-1). Additionally, although it is believed to be highly unlikely, a worst-case scenario was developed and analyzed (Figure 2-7).

This EIS will focus on the portions of the drainages within the Minto Flats watershed shown on the Status Map in this chapter.

1.4 Geographic Setting and Land Status

For the purposes of this EIS, the Minto Flats drainage consists of the rivers and creeks that flow out of the Tanana Hills and into the marshy lowlands west of Fairbanks. The entire watershed is approximately 2.2 million acres. An overview of major geographic features, major land ownership patterns, hydrography, and topography are shown on the Area, Status, and Tributaries and Main Physical Features maps in this chapter.

The major streams of Minto Flats are the Chatanika and Tolovana Rivers and Goldstream Creek. The Chatanika River is approximately 170 miles long from its headwaters at the confluence of Smith and McManus Creeks to its mouth at the Tolovana River. The Chatanika drainage encompasses about 950,000 acres. The mainstem of the Tolovana River is nearly 200 miles long from its formation at the junction of Olive and Livengood Creeks to its mouth at the Tanana River, approximately 64 miles west of Fairbanks. Goldstream Creek is formed at the confluence of Pedro and Gilmore Creeks and traverses 113 miles before it joins with the Chatanika River 40 miles northwest of Fairbanks (Orth 1967).


YUKON
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Livengood
WHITE MOUNTAINS
Beaver Creek
ELLIOTT
HIGHWAY
STEESE HIGHWAY
DAVIDSON DITCH
River
Chatanika
Chatanika
River
Tolovana
Manley Hot Springs
Cleary Summit
Fox
Chena Hot Springs
CHENA HOT SPRINGS ROAD
Chena
River
Tanana
Tolovana
Minto
Ester
Goldstream Creek
Fairbanks
FORT WAINWRIGHT
North Pole
EIELSON AIR FORCE BASE
River
RICHARDSON
HIGHWAY
Nenana
Kantishna
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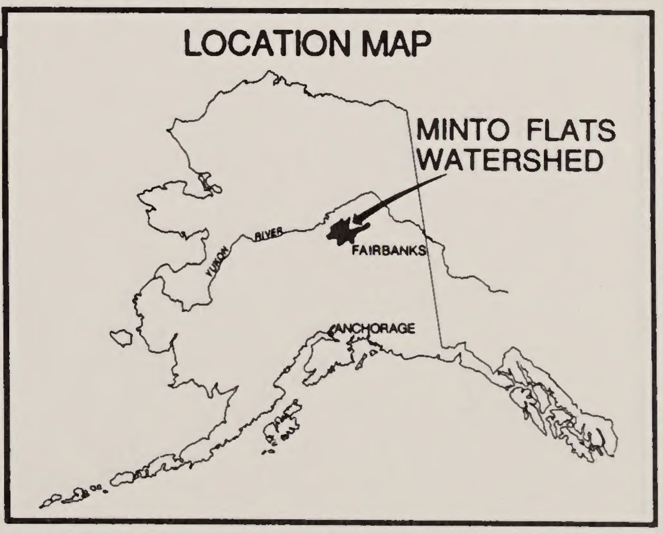
Legend

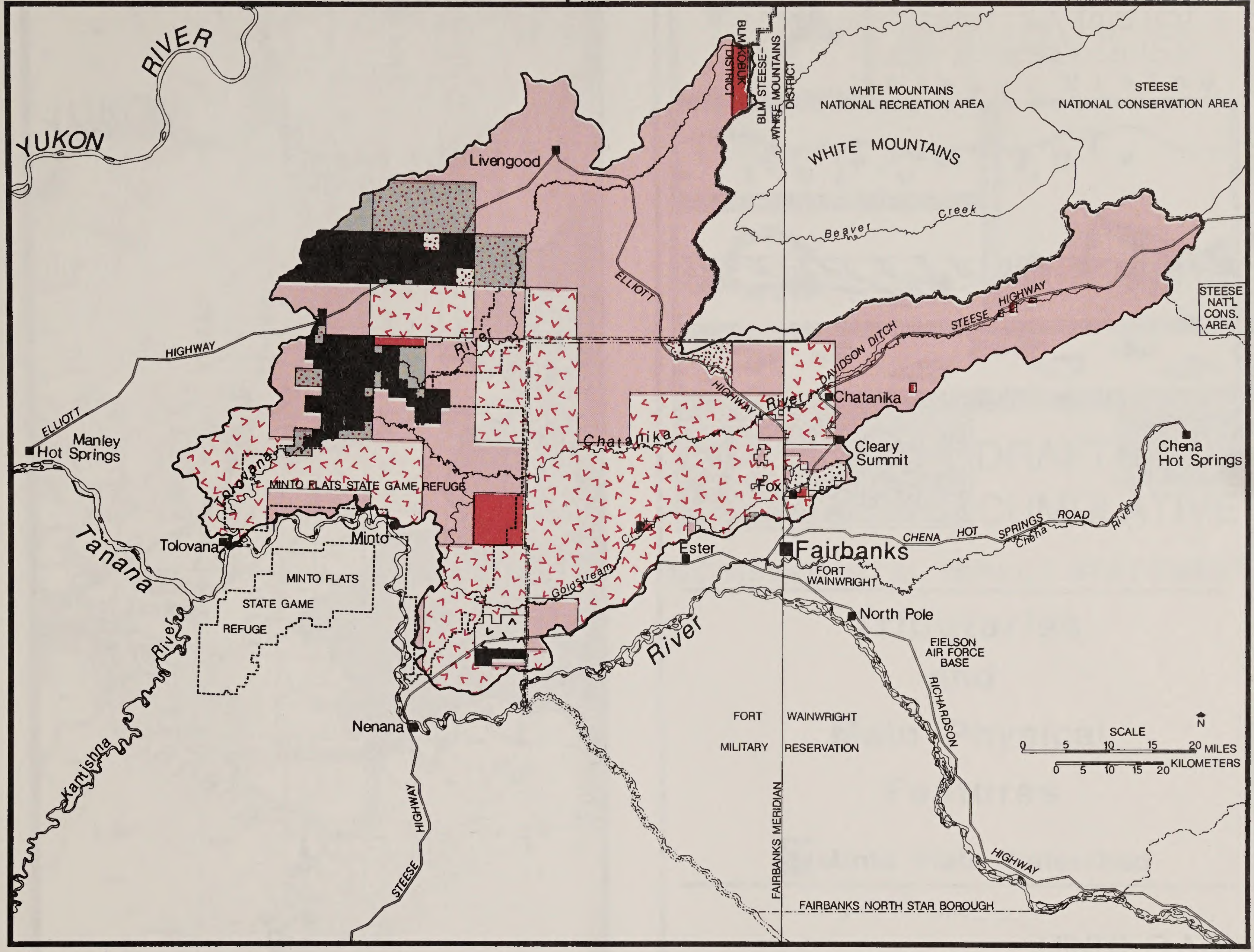
▨ Minto Flats Watershed


LOCATION MAP
MINTO FLATS WATERSHED
YUKON RIVER
FAIRBANKS
ANCHORAGE

Minto Flats Placer Mining

DRAFT
Cumulative Environmental Impact Statement

Status

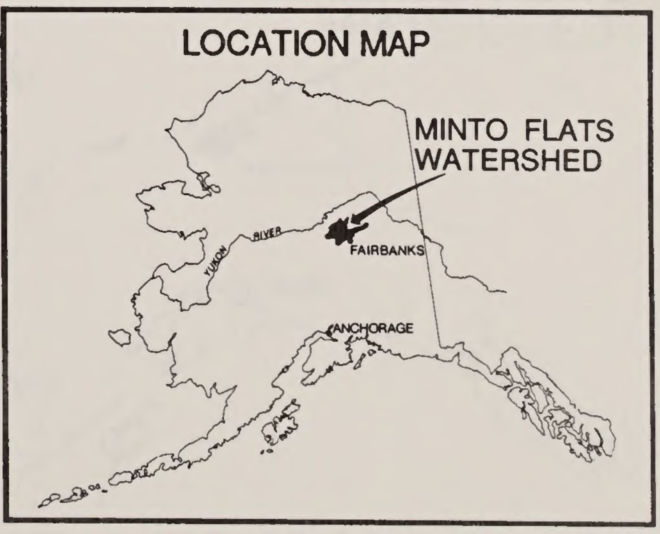


YUKON
RIVER
Livengood
BLM KOBUK DISTRICT
BLM STEESE-WHITE MOUNTAINS DISTRICT
WHITE MOUNTAINS NATIONAL RECREATION AREA
STEESE NATIONAL CONSERVATION AREA
WHITE MOUNTAINS
Beaver Creek
STEESE NAT'L CONS. AREA
ELLIOTT HIGHWAY
STEESE HIGHWAY
DAVIDSON DITCH
Chatanika
Chatanika River
Cleary Summit
Chena Hot Springs
CHENA HOT SPRINGS ROAD
Chena River
Manley Hot Springs
Tolovana
MINTO FLATS STATE GAME REFUGE
Tolovana
Tanana
Minto
Fox
Ester
Fairbanks
FORT WAINWRIGHT
North Pole
EIELSON AIR FORCE BASE
Goldstream Cr.
River
Tanana River
Kantishna
Nenana
STEESE HIGHWAY
FORT WAINWRIGHT MILITARY RESERVATION
RICHARDSON HIGHWAY
FAIRBANKS MERIDIAN
FAIRBANKS NORTH STAR BOROUGH
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS
N

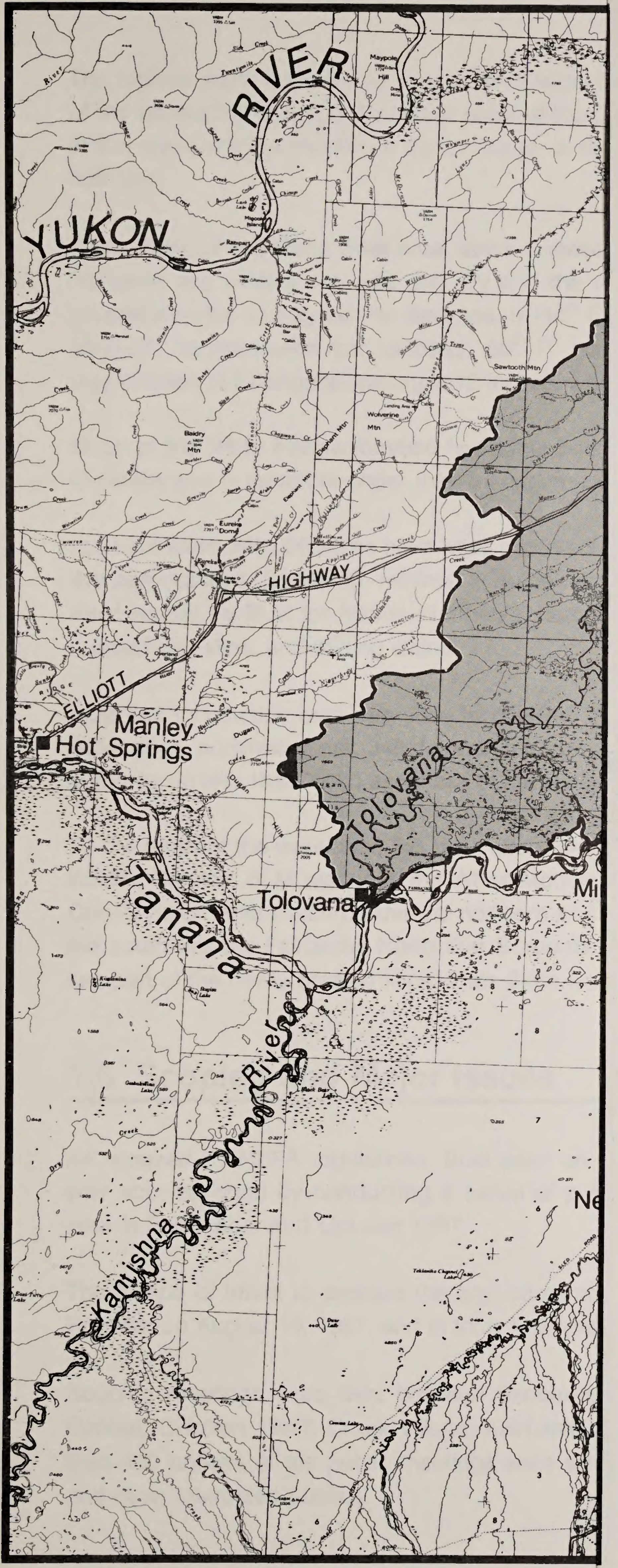
Legend

- ▨ Patented State lands
- ▒ Tentatively approved State lands
- 🟥 State selected lands
- ░ Topfiled/suspended State selected lands
- ▨ Patented Native lands
- ■ Interim conveyed Native lands
- ▩ Native selected lands
- ░ Withdrawn lands

Note: The Minto Flats State Game Refuge encompasses only state lands within the refuge boundary. Status listed in legend is shown within the watershed only. Status obtained from BLM's Alaska Automated Lands Record System. There are about 265 patented mining claims as well as other private lands throughout this watershed.


LOCATION MAP

MINTO FLATS WATERSHED
FAIRBANKS
ANCHORAGE
YUKON RIVER


YUKON
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Manley Hot Springs
Tolovana
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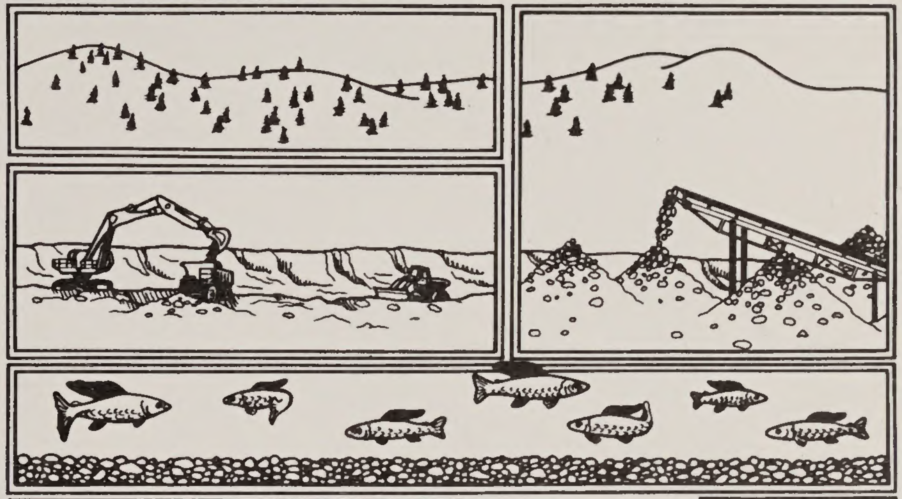
Tanana
River
Kantishna
Sawtooth Mtn
Wolverine Mtn
Baldry Mtn
Eureka Dome
Elephant Mtn
Rampart
Mi
Ne

MINTO FLATS

Placer Mining

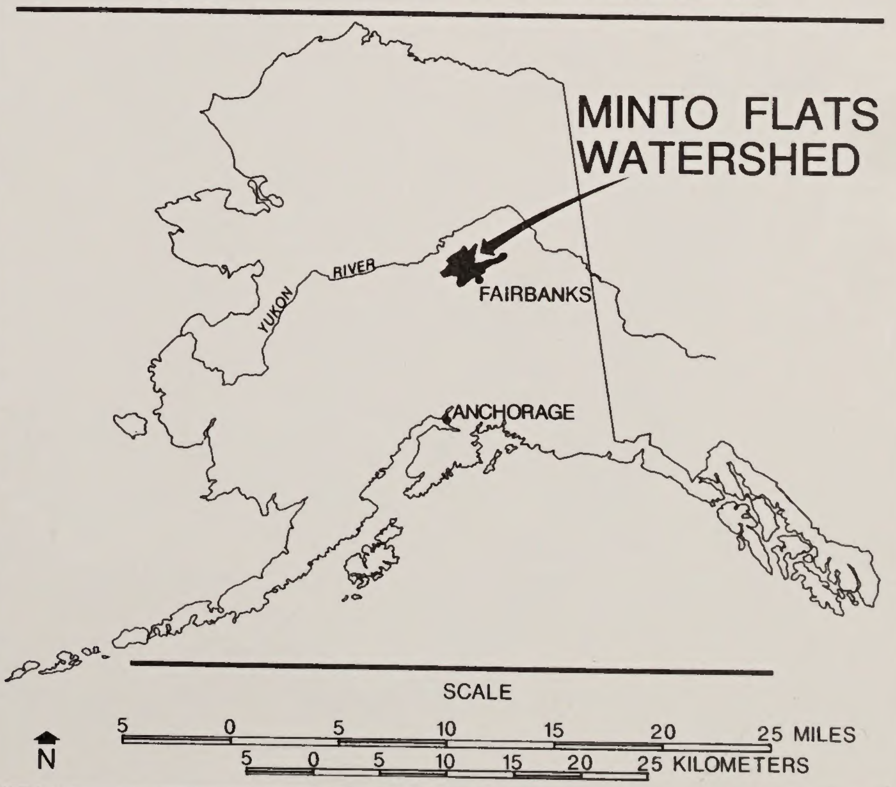


DRAFT CUMULATIVE

ENVIRONMENTAL IMPACT STATEMENT

Tributaries and Main Physical Features

▨ Minto Flats Watershed


MINTO FLATS WATERSHED
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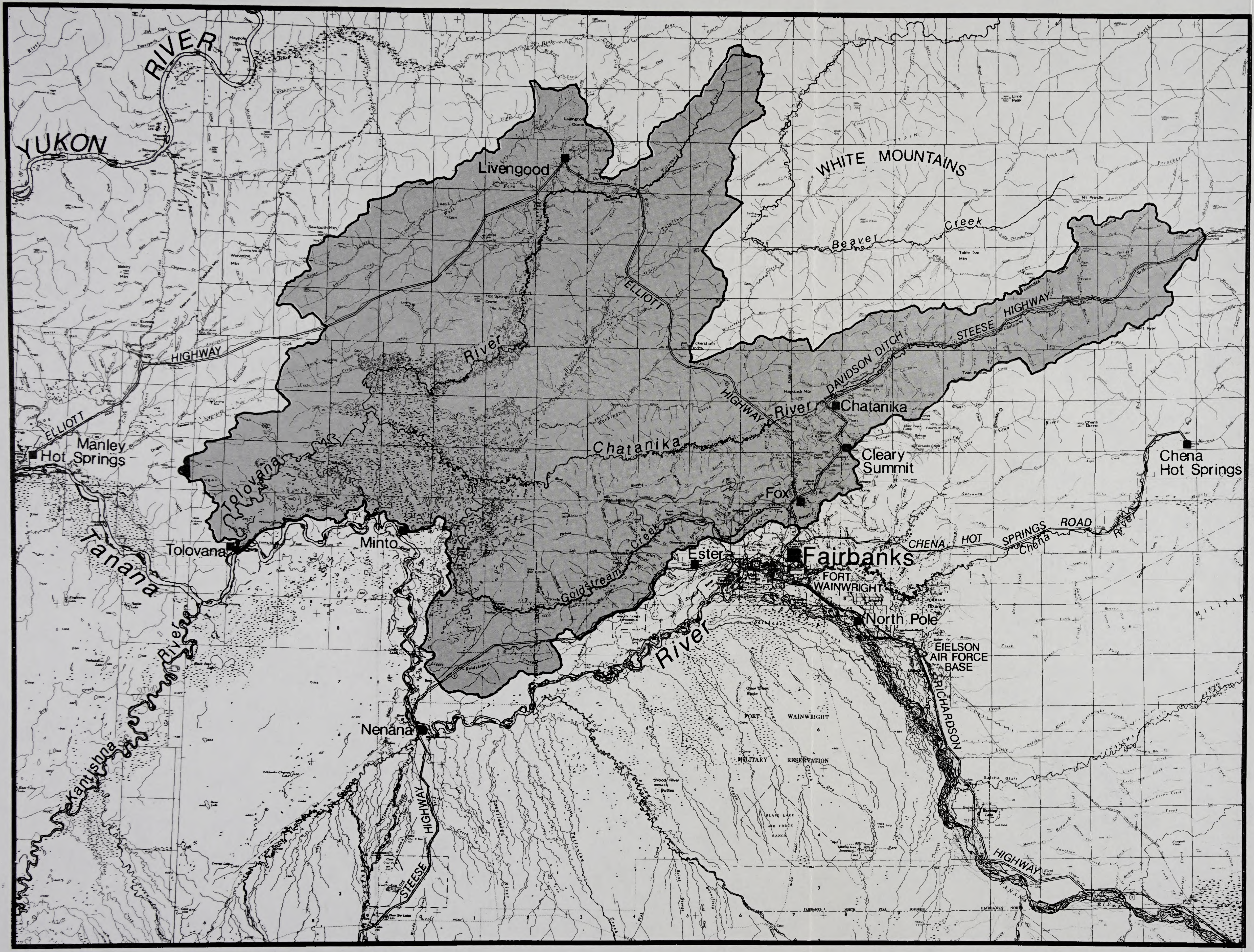
YUKON RIVER
WHITE MOUNTAINS
Livengood
Beaver Creek
ELLIOTT HIGHWAY
River
HIGHWAY
ELLIOTT
Manley Hot Springs
Tolovana
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HIGHWAY
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Ester
Fairbanks
FORT WAINWRIGHT
North Pole
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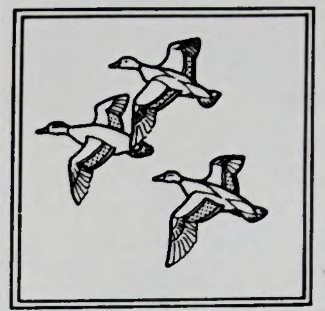
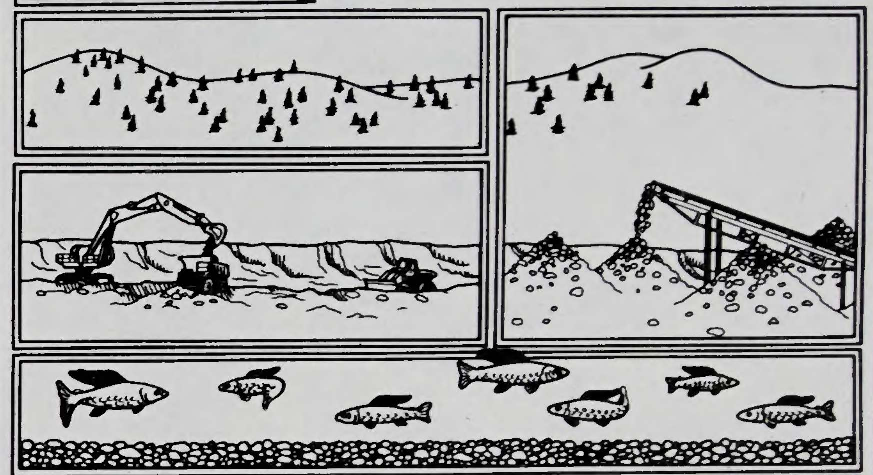
River
MILITARY
FORT WAINWRIGHT MILITARY RESERVATION
Nenana
STEESE HIGHWAY
Kantishna River



MINTO FLATS

Placer Mining

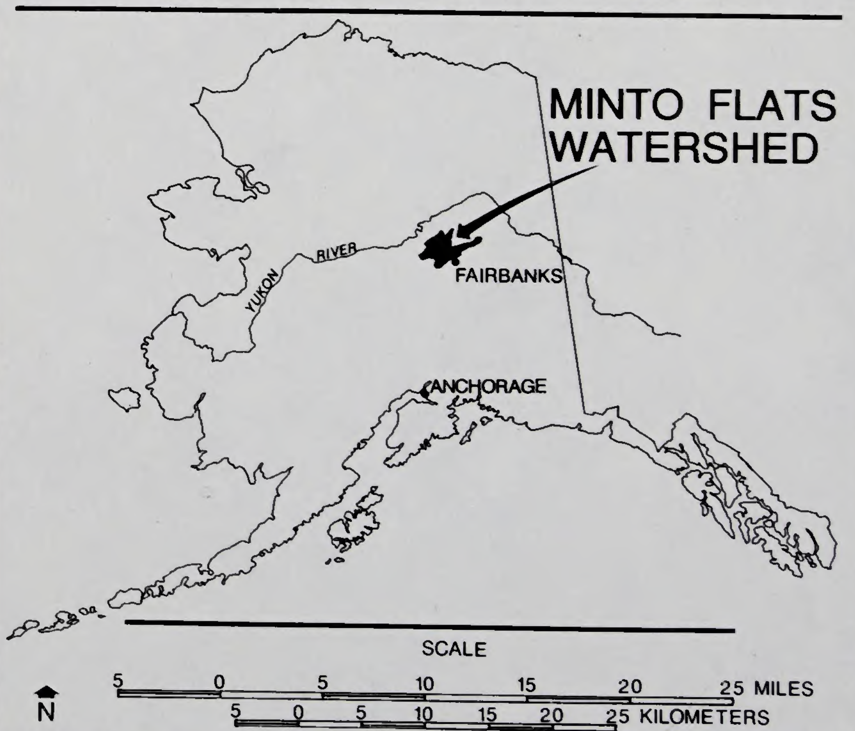


DRAFT CUMULATIVE

ENVIRONMENTAL IMPACT STATEMENT

Tributaries and Main Physical Features

▨ **Minto Flats Watershed**


MINTO FLATS WATERSHED
YUKON RIVER
FAIRBANKS
ANCHORAGE
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5 0 5 10 15 20 25 MILES
5 0 5 10 15 20 25 KILOMETERS

The highest point in the study area is Mt. Prindle (5,286 feet) which is located in the eastern portion of the watershed. Elevations in other parts of the drainage vary from 2,000 to 3,500 feet. Minto Flats, in the southwestern portion of the drainage, is the lowest point in the study area at approximately 300 feet.

The climate of the Minto Flats area varies somewhat because of its size and variations in elevation. However, the winters are cold and dry and the summers are warm, but short. The mean January temperature for Livengood, for instance, is -10^{o} F., and the mean July temperature is about 72^{o} F., although temperatures can exceed -50^{o} F. some winters and 90^{o} F. some summers. Annual precipitation at Livengood averages 12 inches, which includes 50 inches of snow (Selkregg 1974).

Much of the Minto Flats watershed has either been Tentatively Approved to or selected by the State of Alaska and is therefore under their management.

Approximately 240,000 acres have been patented or Interim Conveyed to, or selected by Alaska Native corporations. Scattered, minimal acreage has been conveyed by patents or certificates of allotment issued by BLM for Native allotments, homesteads, homesites, trade and manufacturing sites, headquarter sites, and mining claims.

BLM has jurisdiction over very little land within the Minto Flats watershed. Virtually the only lands BLM does administer are 348 federal mining claims which average 20 acres. Thus, BLM has authority on less than 7,000 acres out of a watershed total of 2.2 million acres.

To the north of the watershed lies the Yukon National Wildlife Refuge managed by the U.S. Fish and Wildlife Service. BLM manages the White Mountains National Recreation Area and Steese National Conservation Area which border the northern and eastern portions of the watershed respectively. To the south lies the Fairbanks North Star Borough. The central and southwestern portion encompasses part of the newly-created Minto Flats State Game Refuge.

1.5 Scoping and Major Issues

As required by NEPA regulations, BLM used an open process to gather public input. Initially, this was accomplished by conducting a series of public meetings in locations throughout the affected area in September and October 1987.

The Notice of Intent to prepare the environmental impact statements was published in the Federal Register on August 18, 1987, and in local newspapers in late August 1987.

Scoping meetings were held between September 9, and October 6, 1987, at Livengood, Minto, Central, Chicken, Birch Creek Village, Fairbanks, and Anchorage, Alaska. At the same time, more than 450 notices of the public meetings were sent out to miners, environmentalists, Native groups, and other interested publics.

The BLM also invited participation from other government groups, private organizations, the placer mining industry, and concerned individuals. At the scoping meetings a description of the EIS process and the proposed activity was provided by the appropriate BLM District Managers. The meetings were then opened to members of the public to voice their concerns and to ask any questions about the issues. All comments were recorded on tape. Members of the public wishing to submit written comments on scoping and issues were requested to do so before October 20, 1987. All written and oral presentations were considered and incorporated into a list of significant issues.

Significant issues include:

- **What are the impacts of placer mining operations on water quality?**
- **How are water quality standards regulated and enforced and who performs this function?**
- **What are the impacts of placer mining on terrestrial habitats?**
- **What are the impacts of placer mining on subsistence?**
- **Have reclamation practices and improved management under the 43 CFR 3809 regulations occurred since 1981?**
- **What are the impacts of other agency laws and regulations on the placer mining industry?**

Specific coordination meetings were held with various State of Alaska agencies such as the Department of Natural Resources (DNR), Department of Environmental Conservation (ADEC), Department of Fish and Game (ADF&G), and the Office of Management and Budget, Office of the Governor. Meetings were also held with the U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (COE), the National Park Service (NPS), and the U.S. Fish and Wildlife Service (USFWS).

By December 1, 1987, more than 30 written responses were received. Chapter Five, Consultation and Coordination, identifies the contacts, participation, and coordination more fully.

1.6 Relationship to BLM Policies, Plans and Programs

Management on BLM lands is guided by existing laws, established planning documents, and programmatic and regulatory guidelines.

For the Minto Flats EIS this includes:

- Surface Management of Public Lands Under the U.S. Mining Laws, 43 CFR 3809 - 1980
- Surface Management - BLM Alaska State Handbook Supplement - 1986
- Alaska National Interest Lands Conservation Act (ANILCA), P.L. 96-487 (94 Stat. 2371), Dec. 2, 1980
- Federal Land Policy and Management Act (FLPMA), 43 U.S.C. 1707, et seq. - Oct. 21, 1976
- Other regulations found in the Code of Federal Regulations.

The above laws and policies identify the general standards under which placer mining may take place in the drainages of the Minto Flats watershed. Where necessary, specific stipulations may be attached to mining Plans of Operations.

Congress, in FLPMA, 43 USC 1732(b), provided that "in managing the public lands the Secretary shall, by regulation or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands."

The regulations in 43 CFR 3809.0-5(k) define "undue or unnecessary degradation" as "surface disturbance greater than what would normally result when an activity is being accomplished by a prudent operator in usual, customary, and proficient operations of a similar character...." Failure to initiate and complete reasonable reclamation may, and failure to comply with applicable environmental statutes will, constitute unnecessary or undue degradation. The BLM has recognized this by making compliance with these laws a specific requirement for any mining operation (43 CFR 3809.2-2).

The principal federal regulatory device to ensure water quality is the Clean Water Act, 33 USC 1251, et seq. However, water quality and its associated environmental problems are extensively regulated by other statutes (Section 1.8) which BLM does not administer. COE regulates placement of dredged and/or fill material in waters and wetlands under Section 404 of the Clean Water Act.

Water pollution control is specifically regulated and permitted on the federal level by the EPA and the COE (33 USC 1311, 1342, 1344), and by the State of Alaska (A.S. 46.030.50). Water quality standards are established and certified by the State (33 USC 1313, 1341). Other agency permits are summarized in Section 1.7.

BLM would continue to review and authorize individual Plans of Operation for placer mining under 43 CFR 3809 and the Alaska 3809 Handbook, as well as other applicable laws and regulations. BLM land use plan amendments may be needed if it appears that any land use classification needs to be changed.

Figure 1-2 illustrates some of the different guidelines and responsibilities of BLM, other federal agencies, and the State of Alaska in managing placer mining on the public lands. The following section more fully describes the roles of other agencies.

1.7 Relationship to Non-BLM Policies, Plans and Programs

Approval of a Plan of Operation is contingent on the operator meeting all other applicable State and federal laws and regulations. These include appropriate water quality standards promulgated by EPA and Alaska DEC. Plan approvals require that the operator receive authorization of work subject to Section 404 (Clean Water Act) from the COE, Alaska District.

Agency	Legal Guidelines & Plans for Management	Responsibility of Agency	Enforcement Responsibility of Agency
BLM	Resource Management Plan 43 CFR 3809 regulations	Surface management	Due and neccessary mining action
EPA	Section 401 of Clean Water Act	Water quality	Water standards
COE	Section 404 of Clean Water Act	Dredge and fill in waters and wetlands	Terms and conditions of COE permits
State of Alaska	Clean Water Act State regulations	Water quality Anadromous fish	State standards

Figure 1-2. General responsibilities of applicable agencies concerning placer mining. This table applies to State, Federal and private mines. BLM evaluates the cumulative impacts of all mines, but can only manage within its jurisidiction.

> "Where the BLM has evidence of suspected noncompliance with the State or federal water quality laws and regulations, the appropriate office of the EPA and/or DEC will be notified. The EPA and/or DEC have the responsibility for enforcement of the Federal Water Pollution Control Act and applicable regulations" (DOI 1986c).

The COE has jurisdiction over placing dredged or fill material in wetlands and waterways, construction or any structure in or over navigable (COE definition) and tidally influenced waters, excavation of material from these waters, or any obstruction or alteration in such waters. Appendix F-1 discusses the responsibilities and regulatory program of COE in more detail.

Section 10 of the Rivers and Harbors Act of 1899 requires permits for any construction or activity that alters the courses, current, condition or navigable capacity of a "navigable water" as defined by COE.

Section 404 of the Clean Water Act requires permits for placing dredged or fill material in all waters, including wetlands as defined by COE.

This EIS evaluates standards of various agencies in the alternatives. While BLM cannot implement other agency standards, it can assess the cumulative impacts of these standards. In the case of the COE and EPA the standards and procedures are under discussion and this evaluation is not meant to suggest these are the final agency recommendations.

Additionally, the BLM will coordinate with other agency plans. Plans of agencies with adjacent land holdings include:

- Alaska Interagency Fire Management Plan Upper Yukon, Fortymile River, BLM - 1984
- The Tanana Basin Area Plan for State Lands, State of Alaska - June 1985
- Yukon Flats National Wildlife Refuge Final Comprehensive Plan - October 1987

- Fairbanks North Star Borough Comprehensive Land Use Plan - 1988

After review of these plans, the BLM finds no inconsistencies between its management direction and the other plan recommendations.

1.8 Applicable Laws and Regulations

BLM and COE must comply with a multitude of other laws, regulations, and federal Executive Orders such as the Alaska National Interest Lands Conservation Act, the Wild and Scenic Rivers Act, 1968; federal Water Quality Requirements (Clean Water Act, Federal Water Pollution Control Act, Safe Drinking Water Act), the Coastal Zone Management Act of 1972, federal air quality requirements (Clean Air Act), federal solid waste requirements (Solid Waste in Disposal Act, Resource Recovery Act), endangered and threatened wildlife and plants (Endangered Species Act), Archaeological Resources Protection Act of 1979, preservation of antiquities (Antiquities Act), historic and prehistoric resources (National Historic Preservation Act, Executive Order 11593), Areas of Critical Environmental Concern (FLPMA Section 202 (c) 3), flood plains (Executive Order 11988 and FLPMA), wetlands (E.O. 11990 and 11988), Prime Farm Land, Wilderness, and the National Environmental Policy Act. Additionally, placer miners may have to obtain numerous permits and approvals from federal and State agencies in order to mine (Appendix A-2).

1.9 Cooperating Agency

The U.S. Army Corps of Engineers is a cooperating agency on this EIS. To the extent possible, this EIS provides NEPA documentation that can be incorporated into future authorization of work by the COE.

At the present time, the COE does not have reclamation standards for placer mining, nor is it in the process of developing such standards. Any reclamation required by a Department of the Army permit will be determined on a case-by-case, site-specific basis for each individually authorized project. In addition, certain requirements for reclamation may be associated with general permits and/or any special procedures such as the proposed abbreviated processing, if issued.

As a cooperating agency, the COE assisted BLM in scoping processes and in reviewing the development of this draft. The review and comments pertain to COE areas of jurisdiction and authority, i.e., flood control, navigation, and regulatory functions. Members of the COE staff have contributed consultation and document review throughout the preparation of the EISs to ensure that the procedural and statutory requirements of the COE are satisfied.

The COE's permit program regulates development of the nation's waters and wetlands through its public interest review process. Within the drainages of the Minto Flats watershed, the COE has jurisdiction over work subject to Section 404 of the Clean Water Act, i.e., the placement of dredged and/or fill material into waters of the United States, including wetlands, stockpiling overburden and placer-bearing deposits, construction of stream diversions, roads and foundation pads, reclamation and similar works. Issuance of a COE permit is required for work proposed on State and private as well as federal mining operations. See Appendix F-1 for a description of the COE regulatory program.

MINTO
FLATS

Chapter II
Description of Alternatives

Section		Page
2.1	Introduction	2 – 1
2.2	Development of the Alternatives	2 – 1
2.3	Description of the Alternatives	2 – 2
2.4	Alternatives Considered, but Eliminated from Further Analysis	2 – 12
2.5	Summary of Environmental Consequences of the Alternatives	2 – 14

2.1 Introduction

The National Environmental Policy Act and the corresponding Council on Environmental Quality regulations require development of alternatives for a proposed action. This Proposed Action and the alternatives to it are the base for the comparative analysis of environmental consequences of an action. The purpose of the alternatives is to provide a range of management options for the final decision about the Proposed Action. See Figure 2-7 at the end of this chapter for a comparison of pre-1981 impacts with those of the 1987 mining season, and projected 1998 impacts under the Proposed Action and the alternatives.

2.2 Development of the Alternatives

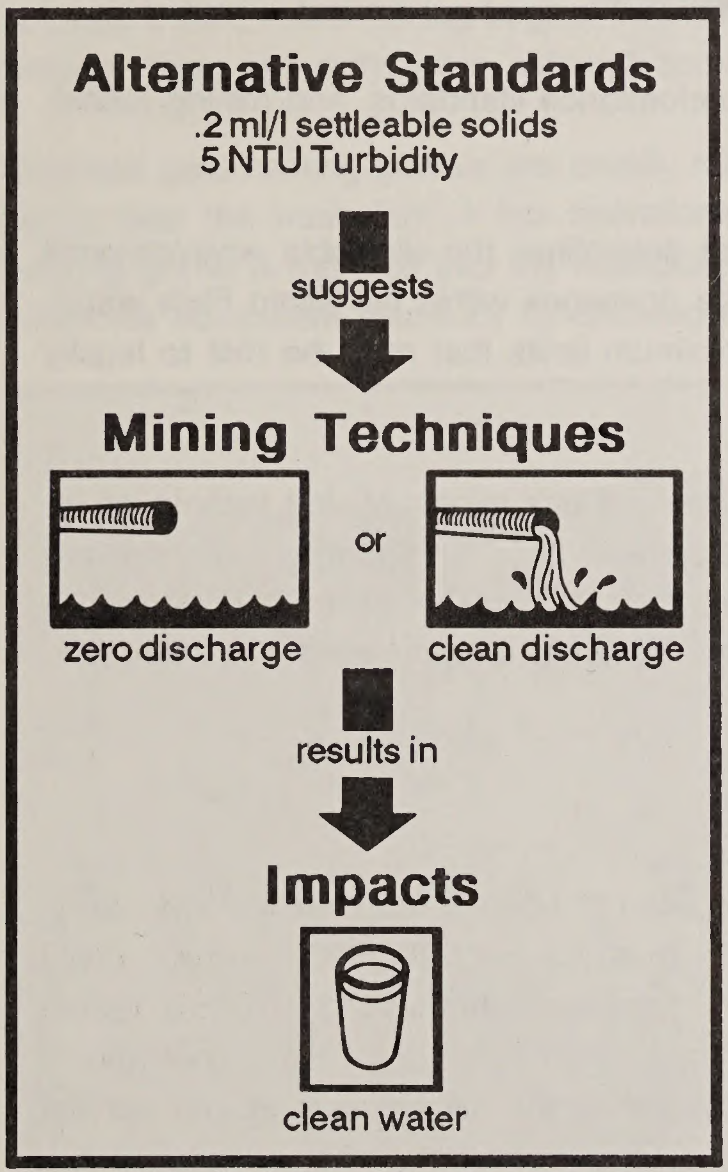


Figure 2-1. Relationship of standards, mining techniques, and impacts.

The alternatives have been designed to address the two major objectives of the study (Section 1.1): 1) consider performance standards under which placer mining may be conducted on federal lands in the area, and 2) comply with Court Orders to conduct a subsistence evaluation under ANILCA Section 810 and the follow up cumulative impact environmental analysis for the drainages within the Minto Flats watershed, and prepare the corresponding documents.

Additionally, issues and concerns raised by the public and other agencies during the scoping process were carefully considered and incorporated into the final alternatives where appropriate. Public comments from scoping are summarized in Chapter Five.

An initial set of alternatives was published in the Notice of Intent for the preparation of this and the three other placer mining EISs (DOI 1987e). These alternatives provided a basis for discussion with interested public groups, individuals, and other agencies during the scoping period. After scoping by interested public groups and other agencies, the alternatives were finalized (Section 2.3). These alternatives are the framework for the analysis of the environmental effects and the cumulative impacts of these effects. Action scenarios were developed for the standards outlined in each alternative. These are mining techniques that could be used to meet the performance standards. Environmental impacts were analyzed from these mining techniques (Figure 2-1).

2.3 Description of the Alternatives

Alternatives for this study are based on a range of performance standards. For BLM, the standards are based on the jurisdiction BLM has within the 43 CFR 3809 regulations and mandates of the court injunctions. Other standards used to evaluate cumulative impacts lie within the regulatory and enforcement authority of other State and federal agencies.

The 43 CFR 3809 regulations are general, and allow some interpretation in two main areas: 1) the application of the definition of undue and unnecessary degradation to the environment and specific operations and 2) reclamation of surface disturbance.

Performance standards are used to form the spectrum of the EIS alternatives for these two areas. Alternative A addresses performance standards under discussion by other agencies. Alternative B, the "no mining" alternative, is defined as the "no action" alternative.

As used in this document, these are the definitions for performance standards, and mining techniques:

A **performance standard** is a measurable quantity which determines the allowable environmental impacts resulting from mining and related activities in the drainages within the Minto Flats watersheds (Figure 2-1). These standards set maximum or minimum limits that must be met to legally operate a mine in the watershed.

Mining techniques are the methods miners employ to operate their mines. Mining techniques include activities associated with exploration, access, development, mineral extraction, and reclamation. Techniques used for mining and mitigation measures that are used to meet the performance standards are often site- specific and are defined in the appropriate Environmental Assessment (EA) for a Plan of Operation.

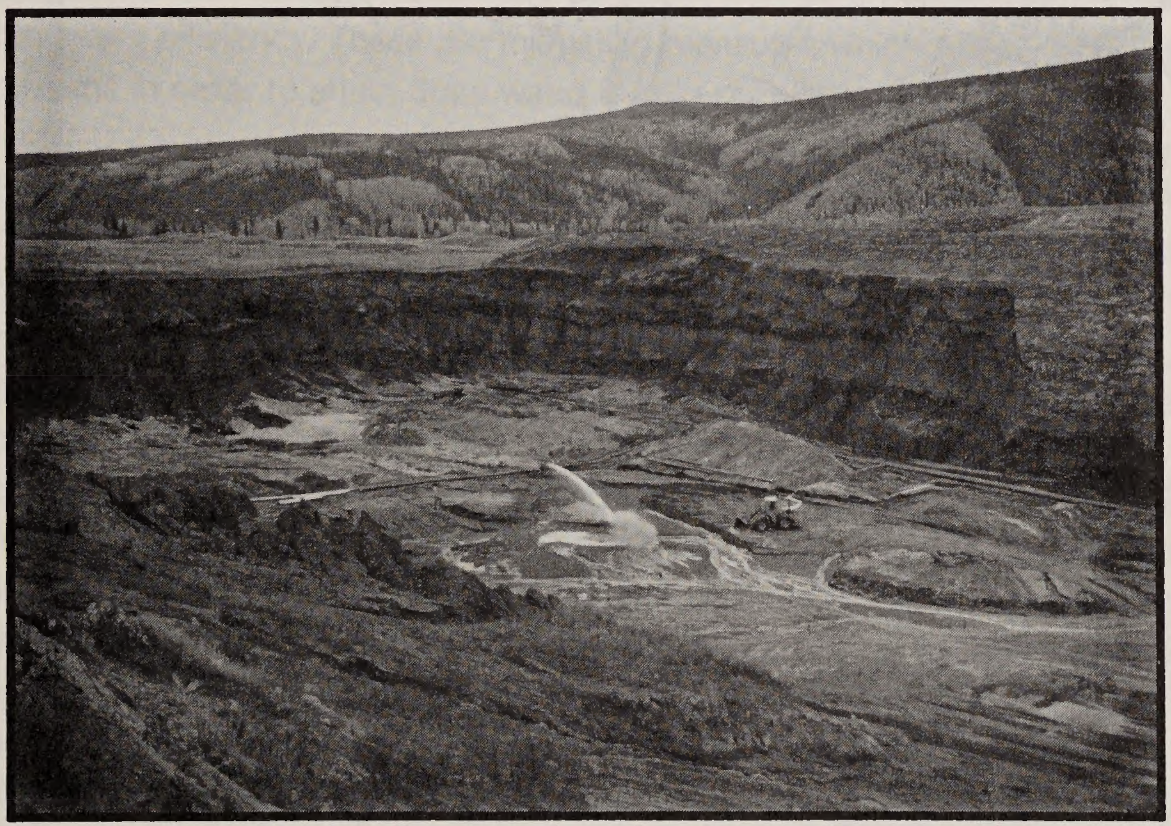
Action Scenario for Mining and Reclamation Activities

There are several mining methods available that could be used to achieve the identified standards. One such scenario is presented here as an example. Other methods are presented in varying detail in numerous publications, such as "Best Management Practices for Placer Mining" (ADF&G 1986c) and "Placer Mining Demonstration Grant Project Final Report" (ADEC 1987a). These other mining methods and their associated surface disturbances are similar to the mining method and surface disturbance descriptions that follow.

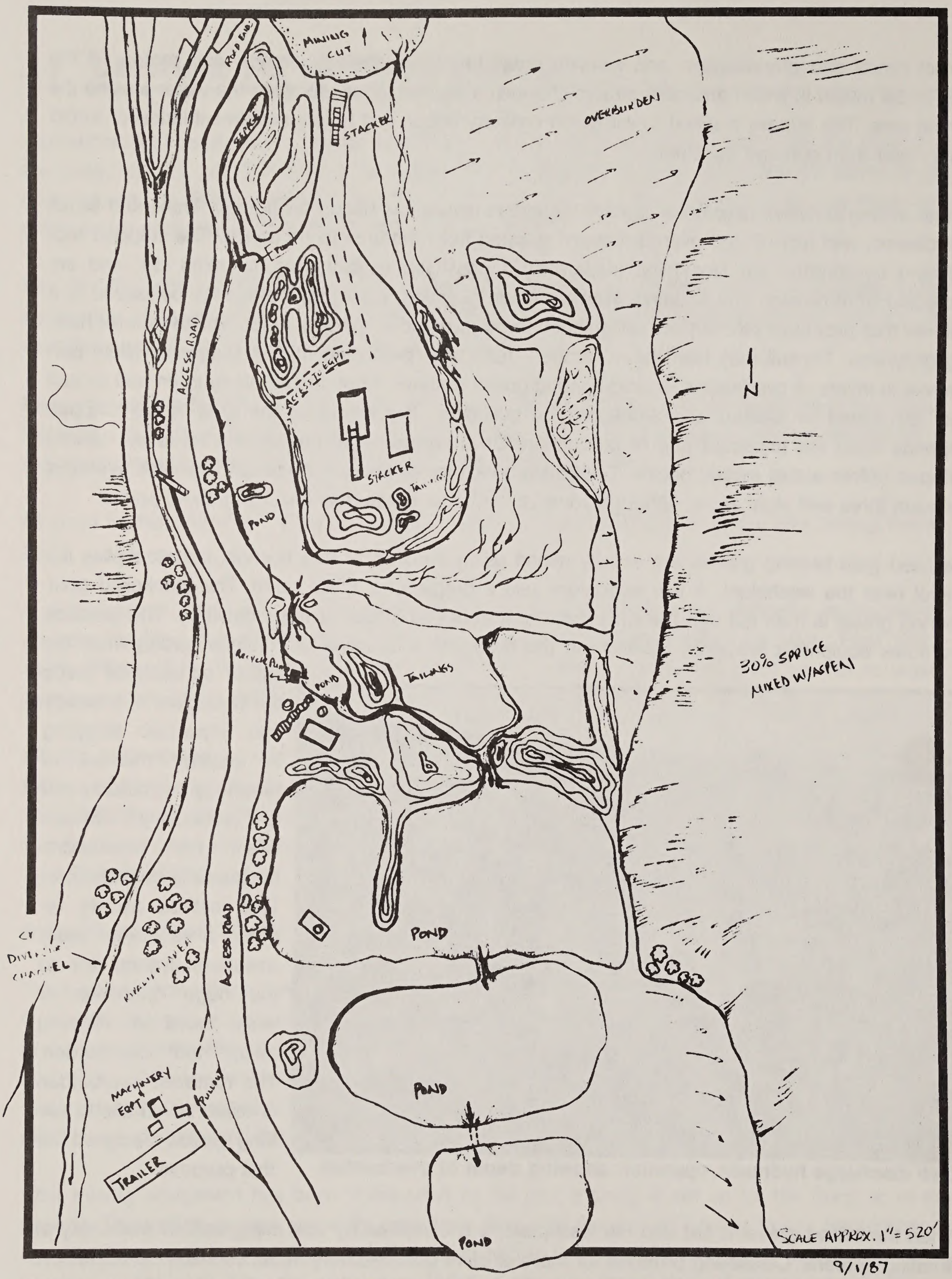
After mining equipment has been transported to the site, a camp is set up for the duration of the season. The mining season generally lasts from June until the ground freezes in late September or October. The camp usually accommodates from two to five people with support facilities for maintenance and storage. After the camp is established, the associated physical mining infrastructure is constructed with a bulldozer or other earth moving equipment. This infrastructure usually consists of two or more settling ponds, associated dikes and spillways, drainage ditches to prevent erosion and collect runoff and groundwater, and working areas for the washplant, pumps, and motors. If the area to be mined is within an active stream channel, a bypass is built to route the water around the mining area. The bypass is diked to withstand ordinary floods and to keep sediment-laden or turbid mine water from entering the stream.

Actual mining activities usually begin after the infrastructure has been constructed. Trees and brush are cleared, and topsoil and overburden are stripped from the area to be mined. The stripped topsoil and overburden are stockpiled (separately if possible), usually near the mine cut, and are protected from erosion and flooding. With adequate planning, these stockpiles may be placed in a manner that promotes efficient site reclamation through reduced material handling and shorter hauling distances. Topsoil may have been stripped during the preceding mining season to allow permafrost in layers of overburden or gold-bearing gravel to thaw. If not, frozen overburden and topsoil may be ripped or blasted and stockpiled by bulldozer. The extent of the area to be stripped depends upon the expected rate of production. On a typical mine, one to two acres are usually stripped before actual mining begins. Total disturbance for an entire mine at any one time averages between three and eight acres, although some of the larger mines may disturb up to 40 acres.

Exposed gold-bearing gravels are usually mined using a bulldozer that pushes and stockpiles the gravel near the washplant. A few operations use a dragline for these tasks. The stockpiled gold-bearing gravel is then fed into the washplant by a front-end loader or large backhoe. This practice promotes equipment efficiency by allowing the bulldozer or dragline to continue mining while the loader or backhoe feeds the washplant at a steady rate. Hydraulic stripping is another method of removing overburden and is particularly efficient when the overburden thickness is considerable. This method usually requires a very large water treatment system due to the huge quantities of water used in washing away the overburden. The removed overburden is captured on site in settling ponds designed for that purpose.


Zero discharge hydraulic operation showing depth of overburden.

When the mined gravel is fed into the washplant, it is classified by size using various stationary or vibrating screens. Classifying provides for more efficient gold recovery, reduced water consumption, and facilitation of mine site rehabilitation, and is practiced by most mine operators. The oversize material, usually larger than two inches, slides out of the washplant into a pile where it is moved by a front-end loader or bulldozer. The undersize material and gold-bearing gravel is mixed with water


MINING CUT
ROAD END
SEEPAGE
STACKER
OVERBURDEN
ACCESS ROAD
ACCESS TO EQPT
STACKER
TAILINGS
POND
N
RECYCLE PUMP
POND
TAILINGS
30% SPRUCE MIXED W/ASPEN
CR DIVERSION CHANNEL
RIPARIAN AREA
ACCESS ROAD
POND
MACHINERY & EQPT
PULLOUT
TRAILER
POND
POND
SCALE APPROX. 1"= 520'

9/1/87

Schematic layout of typical mining operation with washplant and settling ponds.

and flows through the sluice box where the gold and heavy black sands are concentrated. Tailings are the gravel, sand, and other materials which accumulate at the end of the sluice box. Tailings are routinely removed by a loader or pushed away by a bulldozer.

The water that carries the gold-bearing gravel through the sluice box becomes sediment laden and turbid. This "dirty" process water flows from the end of the sluice box through a pile of deposited tailings and into a series of settling ponds. These ponds are designed to hold the "dirty" water long enough to allow the fine sediments to settle out, then the process water is discharged to the adjacent stream. The physical requirements of the ponds are dependent upon the amount of water flowing through the system, the sediment characteristics of the gravels being worked, and the physical characteristics of the site. Most mines utilize a series of small settling ponds to permit flexible water management. Small ponds are usually easier to build, repair, clean, replace, bypass, and rehabilitate. The use of "pre-settling ponds" is encouraged. A pre-settling pond is located in the tailrace between the sluice and the first settling pond. Sands and other heavy settleable solids are collected here where they are easy to separate.

Settling ponds also treat sediment-laden surface water from excavated or stripped areas that would otherwise pollute "clean" surface and run-off water. Another water management practice is to divert clean run-off or ground water around the operation and into an adjacent stream or bypass. This minimizes the amount of clean water that flows into the settling ponds. These water management practices are commonly practiced by most operators. If these practices are not used by the operator's own initiative, they may be suggested as a mitigating measure to improve mine effluent treatment efficiency. These are mitigating measures which ADEC, EPA, and ADF&G apply to priority streams in order to attain State water quality standards.

Some mines in the drainages within the Minto Flats watershed operate with a "no discharge" water management system. The term "no discharge" or zero discharge, implies that no mine effluent will be discharged into the adjacent stream, either by a direct discharge or through seepage. However, most no discharge systems do have occasional discharges, usually due to water seepage through pond dikes. This seepage almost always meets the settleable solids effluent standards, and in most cases, is probably of better water quality than the water discharged from typically operated settling ponds, i.e., less settleable solids and lower turbidity. Carefully designed and implemented water management practices are required to achieve zero discharge of "dirty" water into adjacent streams. Water used in the sluicing process is pumped from the nearby stream through the washplant and into the settling ponds. Water intake from the stream is suspended when the ponds contain adequate water to support continued sluicing operations by recycling pond water to the washplant. In some cases, groundwater seepage into the settling ponds may be sufficient to eliminate the need for adding stream water to the system. The practice of zero discharge and the recycling of mine water contributes to compliance with federal effluent limitations and State water quality standards.

For the typical placer mine on federal claims, reclamation begins upon completion of the final mine cut or at the end of the mining season. If mining has been completed at the location, tailings are moved into the mine cut and the site is leveled or reshaped. The leveled tailings are then covered with available overburden and topsoil. These actions are usually completed with a bulldozer. Settling ponds may be reclaimed by stopping water inflow and allowing the ponds to drain. Tailings are then pushed over the ponds to contain the captured settleable solids and armor the basins from future erosion. Overburden and topsoil, if available, are spread over the armored ponds as well. The reclaimed site is allowed to revegetate naturally.

If mining has not been completed at the location, the mine site is stabilized in preparation for the next mining season. Settling ponds that will be used in future operations are isolated from additional water inflow, while ponds of no further use are reclaimed as discussed above. Berms around ponds, stream bypasses, and the active mine site are reinforced and equipment is moved to high ground.

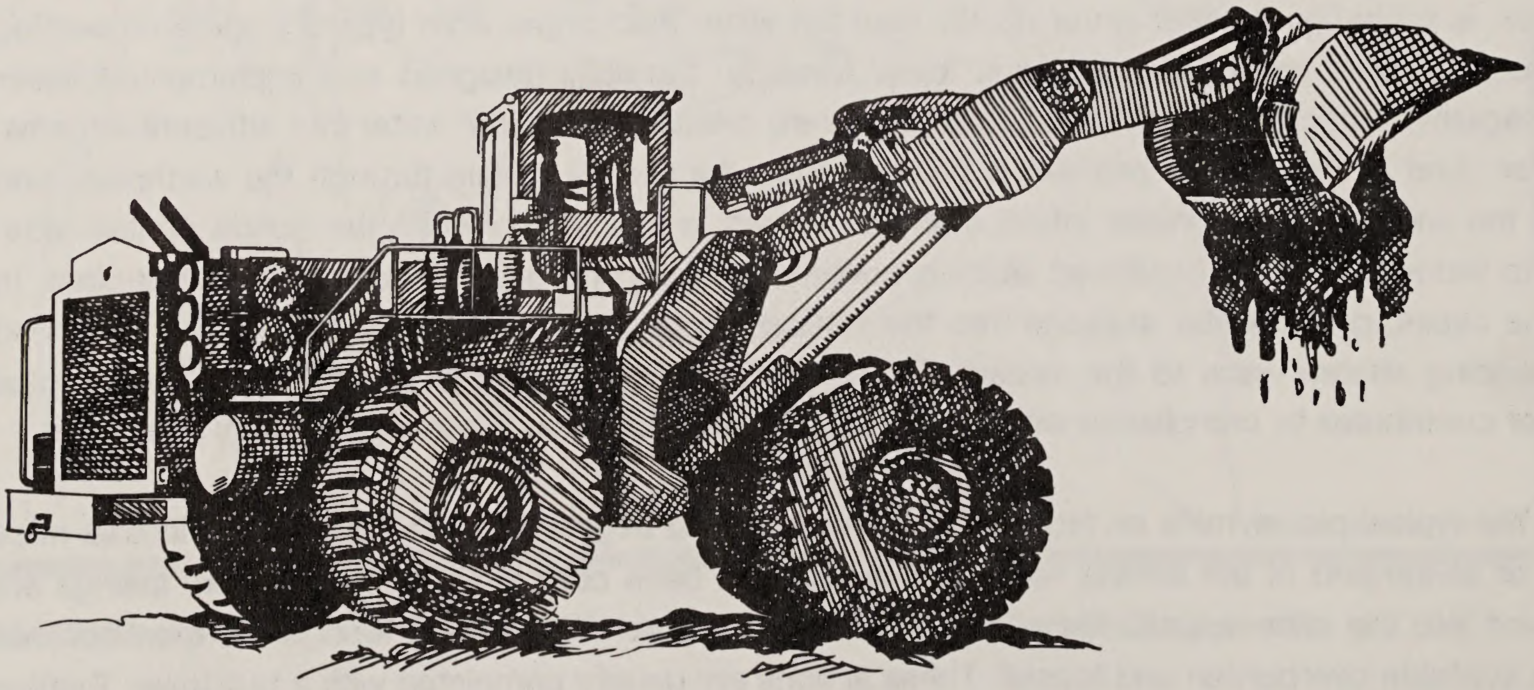
2.3.1 Actions Common to all Alternatives

Existing Laws and Regulations

Some management actions which are applied to mining under all alternatives are those established by existing laws or regulations (Sections 1.6 & 1.8). BLM provides overall management of placer mining on public lands under the 43 CFR 3809 surface management regulations. The COE regulates the placement of dredged and/or fill material into waters of the United States, including wetlands, under regulations found at 33 CFR 320 et seq. Other agencies manage water quality, fish and game populations, and other resources under their corresponding laws and regulations.

BLM Inspections

BLM compliance officers conduct inspections of placer mining operations on federal claims. Currently, all operations are inspected at least once each year, and most are inspected at least once during the mining phase of the operation and once at the end of the season after site reclamation has been completed. The primary concern of the compliance inspector is that the miner is operating appropriately and that reclamation work is acceptable, creating no undue and unnecessary degradation to the environment. During each compliance visit, an inspection record is completed that describes the inspector's observations of the operation. If any problems or violations exist at



Front-end Loader

the mine site, the compliance inspector discusses them with the operator, sets a time frame for correction of the situation, and issues a notice of noncompliance, if necessary. The mine site is revisited to ensure that corrective actions have taken place.

Bonding

Bonding of placer mine operators on federal claims is an enforcement measure which is authorized by the surface management regulations in 43 CFR 3809.1-9. Requiring a performance bond can ensure that a mine site is reclaimed to the satisfaction of the authorized officer. By Bureau policy, bonding of mining operations at the plan level is a discretionary action; however, bonding is required when an operator has established a record of noncompliance. "A record of noncompliance is established when an operator: a) fails to take necessary actions on a notice of noncompliance issued under an approved plan, a previous plan, or a notice, until enjoined in a proper court, or b) conducts operations other than casual use without submitting a Notice or acquiring an approved Plan and fails to file a Notice or a Plan until served a notice of noncompliance" (DOI 1985). The bond amount is usually equal to the estimated cost for BLM to complete adequate reclamation at the mine site.

Access

Mines in the Goldstream Creek drainage are accessible from Fairbanks via numerous paved and gravel roads. All mines operating during the period 1986-87 in the Tolovana River drainage were located within ten miles of the community of Livengood and are accessible by unimproved gravel roads. Livengood is located just east of the Elliott Highway, about 80 miles north of Fairbanks. Mines in the Chatanika River drainage are accessed from Fairbanks via the Steese Highway and then by unimproved gravel roads.

2.3.2 Proposed Action (Status Quo)

The Proposed Action for this EIS would continue the management of mining for claims on federal lands as it was conducted during the summer of 1987 under 43 CFR 3809. In 1987, there were approximately 30 active mines in the drainages within the Minto Flats watershed. About one-third of these mines operated on federal claims. Analysis of the cumulative effects of the Proposed Action includes the past and projected future impacts from federal, State, and private mines, and other non-mining activities in the region.

Standards

The water quality performance standards of significance would be the current EPA effluent guidelines and ADEC water quality standards or the existing EPA/ADEC variance for the operation. The performance standards would be .2 ml/l of settleable solids and 5 Nephelometric Turbidity Units (NTU) above natural conditions when the natural turbidity is 50 NTU or less, and not more than 10%

increase in turbidity when the natural condition is more than 50 NTU, not to exceed a maximum increase of 25 NTU at the mine effluent discharge point (ADEC 1987b). This detailed turbidity standard will be referred to throughout the EIS as the **5 NTU turbidity standard**.

Reclamation under the Proposed Action calls for soils and creek channels to be stabilized, and natural revegetation and restoration.

Action Scenario Under This Proposed Action

Mining activities under the Proposed Action would be expected to be very similar to the actual mining activities that occurred during the 1987 mining season. Mining operations that utilized zero discharge water treatment systems would probably stay with that treatment system. Some operators would probably try to utilize other systems, such as tailing or tundra filtration, to meet the water quality standards, while a few large operations would use flocculation as a secondary water treatment technique. The remaining operations would probably receive EPA variances from the water quality standards and would treat mine effluent entirely through a simple settling process.

Reclamation activities under the Proposed Action would be to reshape tailings to approximate the surrounding topography and to spread overburden and available topsoil over the reshaped tailings. Settling ponds would be reclaimed as previously described and the stream bypass stabilized or reinforced to make it the permanent stream channel. The reclaimed site would be allowed to revegetate naturally.

Evaluating cumulative impacts considers the past, present, and reasonably foreseeable future actions. In this EIS, the past number of acres of disturbance has been calculated by BLM using high altitude color infra-red aerial photographs (Nakasawa 1988). Reports like that of Hagler, Bailly and Co. (1987) have summarized historical data of the drainages within the Minto Flats watershed. The impacts of the present activity are calculated using BLM knowledge and field work, and resources such as the Annual Placer Mining Applications. The future is projected using the methodologies given in Appendix B-1. For the purpose of the present analysis, it must be realized that the actual interrelationships are complex and largely unknown. Cumulative impacts were evaluated with a simple additative model.

The following figures are used to evaluate the present number of mines and to project the future number of mines and associated roads, disturbances, reclamation, and environmental impacts, and place placer mining in perspective as a use of public lands.

Figure 2-2 compares the number of mines in 1987 to the expected number in 1998 under each alternative.

Figure 2-3 is a reclamation and disturbance summary of present mining (1987), used as the baseline, and the projected mining situation for each alternative. Figure 2-4 is a summary of the present (1987) miles of roads and the number of miles of roads projected for each alternative. (Appendix B-1 for methodology).

		Projected 1998		
	1987	Proposed Action	Alternative A	Alternative B
Federal Mines	10	12	9	0
State Mines	20	25	18	25
Total	30	37	27	25

Figure 2-2. Comparison of 1987 State and federal mines against projected 1998 State and Federal mines under the Proposed Action and the alternatives.

		Projected 1998		
Pre-1981 Disturbance-1,744	1987	Proposed Action	Alternative A	Alternative B
Federal Disturbance	155	276	207	0
State Disturbance	105	575	414	575
Total	260	851	621	575
Federal Reclamation	50	168	126	0
State Reclamation	5	0	252	0
Total	55	168	378	0

Figure 2-3. Comparison of 1987 State and federal mine disturbance and reclamation by acres against projected 1998 figures under the Proposed Action and the alternatives.

	1987		1998 PROJECTION					
			Proposed Action		Alternative A		Alternative B	
Jurisdiction	Roads	Trails	Roads	Trails	Roads	Trails	Roads	Trails
Federal	29.8	0	41.7	0	30.4	0	29.8	0
State/Priv.	11.4	0	16.0	0	11.7	0	16.0	0
Joint	0	0	0	0	0	0	0	0*
Total	41.2	0	57.7	0	42.1	0	45.8	0

* All joint trails become state/private roads and trails.

Figure 2-4. Comparison of various 1987 road/trail jurisdictions and projected 1998 jurisdictions by miles.

2.3.2 Alternative A

This alternative focuses on various standards proposed or under discussion by other federal regulatory agencies. All mining operations in the study areas would meet the proposed standards. Figure 2-5 shows a clear comparison of performance standards used for this alternative and the Proposed Action.

Standards

The discharge water quality performance standard for this alternative would be zero ml/l settleable solids and turbidity of zero NTU above natural conditions. Reclamation standards would emphasize restoration to a naturally-appearing landscape configuration, rehabilitation of creek channels, and regrowth of native vegetation. Mining activities would be conducted to minimize impacts to wetlands and riparian zones.

Action Scenario Under This Alternative

Alternative A water quality performance standards would be more stringent than those in the Proposed Action. Under this alternative, the miner would have two realistic options in choosing an appropriate water treatment method for the operation. These options would be: 1) to employ a chemical treatment system to reduce mine effluent settleable solids to zero and turbidity to natural conditions, or 2) to not discharge any effluent into the stream.

Given these choices, most operators under this alternative would probably choose a zero discharge operation because it is presently more reliable and more cost-effective than a chemical system. Chemical treatment systems employ technology which has thus far had only limited success for mining operations in Interior Alaska.

Reclamation standards would be similar to those described in the Proposed Action (Section 2.3.2), except that restoration would be enhanced. Reclamation may include the removal of fine sediments from settling ponds for distribution over shaped tailings, selective seeding or planting of reclaimed areas as appropriate, or constructing habitat to enhance fish populations within disturbed streams.

Further work may be required to meet the reclamation standards of the alternative. This may include fertilizing and seeding or planting with native species, and rebuilding the creek channel in the original floodplain. The creek could be designed to have pools, riffles, and other natural features. Fine materials from settling ponds could be removed and redistributed over the tailings. Access roads and camps could be designed and constructed to reduce impacts on wetlands and riparian zones. Actions of these types would be required on all mining operations, regardless of land status or size.

OPERATIONS	Proposed Action	Alt. A	Alt. B
Water Discharge, including runoff	.2ml/l, 5 NTU turbidity. EPA variances	0 ml/l, 0 NTU turbidity, no variances	N/A
In-stream channel ops.	No limits	Careful/limited	N/A
Vegetation Stripping of area	No limits	No limits	N/A
Soils Topsoil	Save, stabilize against erosion	Save, stabilize against erosion	N/A
Shape of site	Stabilize to reduce erosion	Stabilize to reduce erosion	N/A
Access	Per RMP	Per RMP	N/A

RECLAMATION

Water Creek configuration	Remain in bypass	Reestablish grade & configuration in floodplain	Remain in bypass
Fish habitat	Provide for fish passage; comply with ADF&G regs.	Rebuild w/rocks, pools, riffles, etc.	No requirements
Soils Shape of site	Reshape to approximate surrounding physiography	Reshape to approximate surrounding physiography	Reshape to approximate surrounding physiography
Fines-ponds	Protect from erosion	Respread over tailings	Protect from erosion
Topsoil	Respread over tailings	Respread over tailings	No requirements
Vegetation Revegetation	Natural succession	Fertilize & reseed w/native species	Natural succession
Refuse Human waste	Keep out of stream	Keep out of stream	Keep out of stream
Garbage	Remove	Remove	Remove
Chemicals	Remove	Remove	Remove

Figure 2-5. Comparison of the alternatives for federal operations. Alternative A standards would be met by all operations in the watershed.

2.3.3 Alternative B

Alternative B is the "no action" alternative defined by the District Court. See Figure 2-5 for a comparison of performance standards between alternatives.

Standards

Under this alternative, no applications for Plans of Operations or Notices would be processed or approved by BLM. This action would violate current regulations (43 CFR 2091.1 for accepting application, and 43 CFR 3809.1-6 for processing applications). This action would also violate the 1872 Mining Law which gives a mining claimant the right to operate subject to surface management regulations. Changes would be required in these regulations and laws to legally implement this alternative.

Validity examinations would be conducted for each properly filed mining claim. Appraisals would be made and the owners of valid claims would be compensated accordingly. Stabilization of surface disturbance that has occurred since 1980 would be required on all federal claims. Further restoration would be allowed to proceed by natural processes.

Action Scenario Under This Alternative

This alternative would require that mining cease on all federal claims within the watershed. BLM would conduct validity exams for all recorded claims, appraisals would be made, and the owners would be compensated for their interest in the claims. This would require Congressional appropriation of funds. Reclamation standards would be similar to those under the Proposed Action. Areas disturbed after 1980 would be stabilized with minimal work, and reclamation would be allowed to proceed by natural processes. State and private operators would continue to mine using the same water quality standards that were in effect during the 1987 mining season.

2.4 Alternatives Considered, But Eliminated From Further Analysis

During the scoping process, many alternatives were suggested that were considered for analysis but not selected for further study:

1) Various levels of BLM enforcement, including compliance visits and administration of Plans of Operation applications.

Various levels of enforcement have been included in evaluating the Proposed Action and Alternative A.

2) Requiring specific mining and reclamation methods.

This range of alternatives was not selected for three reasons: 1) The variation in the natural and mineral-bearing characteristics of the mining areas requires site-specific methods. Limiting all operations to a predetermined set of mining methods would reduce flexibility, and could increase environmental impacts. 2) Mining and reclamation technology is in a state of development and transition. Specific methods would rapidly become out of date and limiting. Emerging technologies are generally better both for mineral recovery and for environmental reclamation, and requiring static technology would restrict both activities. 3) These types of factors receive site- specific consideration in the preparation of EA's required for each Plan of Operation.

3) Changes in regulations and standards by other agencies.

This idea was partially used in Alternative A. The changes in standards are limited to those that were actually being proposed by EPA or being discussed by other agencies at the time BLM developed the alternatives in July-November, 1987. Other changes were not incorporated because other agencies are mandated with those tasks, and these standards are outside immediate BLM jurisdiction.

4) Various alternatives which result in less restrictive standards, especially for water quality.

Water quality alternatives are developed from existing and proposed agency standards. This EIS will calculate the cumulative effects of these standards, and BLM's role is to require the operator to comply with all existing State and federal water quality standards.

Pursuant to 33 USC 1371(c)(e), BLM may not impose effluent limitations that are different from those established by EPA and ADEC.

5) Alternatives that would change the water quality standard for the Tolovana River, Chatanika River, and Goldstream Creek from the drinking water standard to the industrial water standard.

These alternatives were not used because they would require action by the State of Alaska. This was not considered to be a "reasonable" alternative for implementation at this time.

6) An alternative with no performance standards and no regulation.

This alternative was not used because it would essentially revisit the issue that the 43 CFR 3809 regulations were originally intended to address. The no regulation alternative is the "no action" alternative evaluated in the "EIS for Surface Management of Public Lands Under the U.S. Mining Laws, 43 CFR 3809" (DOI 1980). A variation of this alternative would set low performance standards, and issue miners a "license" to mine.

7) An alternative with existing EPA/ADEC effluent limitations of 0.2 ml settleable solids and the 5 NTU turbidity standard, but no EPA variances, and a less stringent reclamation standard than the Proposed Action.

This alternative was not used in the Minto Flats EIS because the Chatanika River was designated a Special Priority stream by the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game in 1986. Closer monitoring and cooperation between miners and the State of Alaska since 1984 have resulted in improved water quality on Faith Creek and the middle Chatanika River (Townsend 1987). Also, there are relatively few federal claims in the watershed (13% of the claims), so different reclamation standards on federal claims would have very little change on watershed-wide impacts.

8) An alternative which places emphasis on meeting the goals of the appropriate Resource Management Plan for the watershed.

This alternative was not used because BLM does not have jurisdiction over any lands in the Minto Flats watershed except for the federal mining claims. All of these lands have been top-filed by the State of Alaska or Native corporations.

2.5 Summary of Environmental Consequences of the Alternatives

Cumulative Impacts

The evaluation of cumulative impacts requires the integration of time, space, mining/non-mining, and federal/non-federal actions in a complex and dynamic environment. The spatial aspect is covered by considering the impacts of multiple mining operations in the Minto Flats watersheds (Placer Mining Operations and Access Roads Map, Chapter Three). Time is considered by evaluating the past, present, and reasonably foreseeable actions of placer mining. Past and present impacts are part of the existing environment, discussed in detail in Chapter Three, Affected Environment. The projected number of mines, acreages of disturbance, and miles of roads and trails were calculated using methods outlined in Appendix B-1, and are summarized in Figures 2-2, 2-3, and 2-4. Future impacts are discussed in this chapter, Environmental Consequences. Impacts from non-federal mines are included in the discussions of current environment and projected impacts. In particular, the impacts of Alternative B, no mining on federal claims, shows the effects from mining on State and private mines. Non-mining actions are discussed in Chapters Three and Four as appropriate.

For a summary of the impacts and comparison between alternatives, reference Figure 2-7, which depicts past, 1987, and projected 1998 impacts for the Proposed Action and each alternative.

Projection of Mines

Thirty-seven mines (12 federal and 25 State and private mines) were projected to be operating in the Minto Flats watersheds (primarily in the vicinity of Livengood, the middle and upper Chatanika River drainage, and upper Goldstream Creek drainage) over the next ten years under the Proposed Action. This number was determined by using a one-to-one relationship between the 1987 price of gold and the number of mines operating during 1987 to predict the number of mines expected to be operating in 1998 with an estimated gold price of $600 per ounce. This estimated gold price was approximately a 23% increase over the highest 1987 price of $475 per ounce, so a corresponding increase in the number of mines was projected for 1998. This level of mining activity was projected so that the cumulative environmental effects of increased mining activity within the drainage could be assessed.

Projecting the number of mines that would operate under Alternatives A, was based on the estimated compliance cost of this alternative as compared to the Proposed Action's compliance costs. This cost is listed in Figure 2-6, and comparison clearly indicates that the estimated water treatment cost for Alternatives A is significantly higher than that estimated for the Proposed Action. Due to this significant increase in compliance cost, BLM estimated that there would be a reduction in the number of mines operating under these alternative. Under Alternatives A 27 mines (9 federal and 18 State and private mines) were estimated to be operating in 1998. Under Alternative B, no federal mines would be operating, while 25 State and private mines would be operating under the standards of the Proposed Action.

The water treatment costs cited in Figure 2-6 were taken from an EPA report (EPA 1987a) that analyzed the economic impact of effluent standards on the placer mining industry. In the EPA report, six water treatment technology options were outlined and their associated costs for Alaska were estimated. BLM reviewed these options and selected the two treatment technologies that came closest to meeting the various water quality standards of the Proposed Action and Alternative A. The Proposed Action treatment technology would be a simple settling system that consists of primary and secondary settling ponds operated with an EPA variance for turbidity discharge, similar to treatment technology Option Two. Alternative A, with water quality standards of zero ml/l settleable solids and zero NTU turbidity increase, would require operations comparable to the Option 6c of the EPA report water treatment technology, including zero discharge, 100% recycle of process water, and flocculants. For this system, EPA estimated that the operator's income would be reduced by about 27%, so the number of mines was reduced by that percentage. The costs in Figure 2-6 are representative of a mine that processes 150,000 cubic yards per mining season.

A worst-case scenario to describe a level of placer mining more intense than expected, was analyzed to predict those possible cumulative environmental impacts. This scenario could occur if unforeseeable circumstances caused this high level of activity, such as the price of gold increasing to $2,000 per ounce. The summary of this analysis is presented in Figure 2-7 and the assumptions are listed in Appendix B-2.

2.5.1 Proposed Action (Status Quo)

The effects of the Proposed Action are based on 37 mines (12 federal and 25 State and private) operating continuously for the next ten years.

There should be no significant cumulative impacts on topography of public lands. There would be some short-term modification of site aspect during mining which would not significantly impact the overall topographic setting of the affected area, since the required reclamation would include reconfiguration and stabilization. State and private lands would have some local, long-term impacts on the topography since reclamation on these lands is not required.

There should be no significant impacts on mineral resources.

The soil profile would be completely altered by mining operations on approximately 851 acres of ground. Soil conditions may be impacted by access roads and trails through direct disturbance of the soil profile, enhanced erosion, or from compaction.

Increased levels of turbidity would occur on all actively mined streams. The discharge of particulates from active mines may make a significant contribution to water quality deterioration in the watershed, particularly on Goldstream Creek. The contribution of sediment from non-point sources is unknown and cannot be adequately quantified with existing data, but it is not expected to be significant. The estimated soil loss from the watershed due to erosion and non-point sources in 13,070 tons per day.

The vegetation cover would be destroyed in mine and road areas. A short-term loss of productivity is unavoidable. One hundred thirty-six acres would regrow to a riparian tall shrub community within 30 years of reclamation, with an additional 64 acres within 50 years on mining disturbance in creek bottoms. Six hundred fifty-one acres of new mining disturbance would remain barren or sparsely vegetated.

There are no "listed" of "candidate" threatened or endangered plant species within the watershed; nor are there any endemic species.

Approximately 5,240 acres of wildlife habitat would be physically altered due to mining-related activities. Periodic disturbances to wildlife due to the operation of vehicles and machinery, and human habitation affecting 56,670 acres could result in a low to moderate level of short-term cumulative effects. The principal long-term adverse effect of new mining would be the unavoidable loss of approximately 761 acres of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas for a 30 to 50-year period. The long- term cumulative loss of habitat to federal (191 acres) and State and private (460 acres) mining activities in these areas would probably contribute to a slight reduction in moose population potential. The potential exists for long-term cumulative adverse effects to wildlife if human use of the area increases greatly in crucial wildlife habitats.

The peregrine falcon is the only threatened or endangered species within the watershed. Protective measures would be required for any mining activity planned within one mile of these nests. No anticipated activities are within one mile of any known nest areas.

Physical alteration of streams and increases in suspended sediment from mines in the basin would result in adverse cumulative effects on the aquatic resources. Streams that are blocked to fish passage would also be unavailable as habitat to some fish populations in the affected area. The overall cumulative effect of total suspended sediment in Minto Flats watershed cannot be determined. Fishery resources would remain similar to those present in 1987. The Tolovana and Chatanika Rivers would continue to support numerous fish species and key habitat, while the poor fish habitat and low fish populations would continue in upper Goldstream Creek.

Cumulative impacts on cultural resources in the Minto Flats watershed do not appear to be significant.

Present village-based subsistence usage of the Minto Flats area is downstream from mining activity on BLM lands, and is done principally by residents of Minto village. As shown on the subsistence use area map (Subsistence Use Map, Chapter Three), overall traditional subsistence use of the Minto Flats area by Minto village residents extends northeast to near Livengood, southward to beyond the Chatanika River, and then westward along the Tanana River to beyond its confluence with the Tolovana River. Thus, the past, current, or potential impacts to subsistence users and resources from mining are indirect to Minto village, and would involve events upstream from where village- based subsistence users usually go for harvesting resources at the present time. Currently, there is evidence that certain customarily used riverine and lake navigational access routes in the Minto Flats area near Minto village have been obstructed to some degree by sedimentation that came in part from historic upriver mining areas. Consequently, a significant restriction to subsistence uses has developed in such areas and is occurring today, with past and present mining involved in causing it to some greater or lesser degree. However, mining in 1987 on federal claims appears not to have notably further added to this sedimentation and thus to the ongoing restriction to subsistence uses. With mining under the Proposed Action, downstream subsistence uses still would be significantly restricted, but due primarily to ongoing sediment redeposition and no reclamation standards on non-federal lands. This cumulative significant restriction would continue for several years even if all mining ceased immediately in the Minto Flats watershed because certain now-sedimented areas are likely to remain so for the foreseeable future. As to the potential for other mining-related impacts to subsistence uses, none are thought likely. This includes consideration for potential future increased mining-related access, which, if it occurs, would not cross the portions of the Minto Flats area used by the Minto villagers for subsistence purposes.

Placer mining impacts to fish and wildlife habitat and populations may affect the quality of hunting, fishing, and wildlife viewing opportunities. Additional access roads would also provide for increase recreation of the watershed; however, these roads would impact the visual resources.

Mining expenditures, total output, mining employment, total employment, mining income, and total income would also increase by about 23%.

Costs Per Federal Mine	1987 (10 mines)	Proposed Action (12 mines)	Alternatives A (9 mines)	Alternatives B (No mines)
Reclamation Cost	$1,500	$2,000	$3,400	NA
Water Treatment Cost	$5,200	$5,200	$47,000	NA
BLM Administrative Cost	$1,800	$1,800	$2,600	See Caption

Figure 2-6. Estimated costs associated with implementation of each alternative. Sources: BLM. EPA. NPS. For Alternative B. validity examinations and appraisals were estimated to cost $2,000 per claim, and the net present value of each claim was estimated to be between $12,000 and $335.000. See Appendix B-3 for methodology for computing costs.

Annual costs for water treatment and reclamation for all federal mining operations would be $62,400 and $24,000 respectively. Administration and enforcement of the Surface Management program for placer mining would cost BLM about $21,600 annually (all values in 1987 dollars). Figure 2-6 is a summary of the estimated unit costs for federal mines associated with the implementation of each alternative. Costs for State and private mines were not estimated because BLM has no regulatory authority for these operations; however, water treatment costs would probably be similar to the costs for federal mines. No reclamation would be required for State and private mines.

2.5.2 Alternative A

The effects of this alternative are based on 27 mines (9 federal and 18 State and private) operating continuously for the next ten years. The effects are the same as the Proposed Action except for the following differences.

The soil profile would be completely altered by mining operations on approximately 621 acres of ground.

There would be no direct impact on water quality from mining operations; however, it is likely that occasional high water or failure of settling ponds would introduce collected sediments into the stream channel. The soil loss from the watershed due to erosion and non-point sources would be 13,128 tons per day.

One hundred forty-four acres of disturbed ground would regrow to a riparian tall shrub community within 25 years of reclamation, with an additional 113 acres within 50 years on mining disturbance in creek bottoms. Three hundred sixty-four acres of new mining disturbance would remain barren or sparsely vegetated.

Approximately 4,887 acres of wildlife habitat would be physically altered due to mining-related activities. Periodic disturbances to wildlife due to the operation of vehicles and machinery, and human habitation affecting 41,486 acres could result in a low to moderate level of short-term cumulative effects. The principal long-term adverse effect of new mining would be the unavoidable loss of approximately 818 acres of the moose habitat winter range for a 30 to 50 year period. The long-term cumulative loss of habitat to federal (122 acres) and State and private (243 acres) mining activities in these areas would probably contribute to a slight reduction in moose population potential.

Impacts to fishery resources would be less than those discussed in the Proposed Action. The reduction in impacts would probably be most notable in the Goldstream Creek drainage; however, the extent of fishery resource recovery cannot be determined.

A significant restriction to subsistence uses would still remain in the Minto Flats area until the cumulative effects of past sedimentation are substantially reversed. Whether or not this is possible is uncertain since the Minto Flats area is a natural sediment trap and once sediment is deposited it may be there indefinitely. In the short term, the impacts on subsistence uses and resources would be similar to those under the Proposed Action, although some short-term fish and wildlife productivity gains might occur. This is because reclamation standards would be required on non-federal lands as well as federal lands, this potentially decreasing sedimentation entering riverine areas.

Impacts to recreation opportunities would be less than those anticipated in the Proposed Action. Visual resources would be impacted the least in this alternative due to reclamation at all mine sites.

Mining expenditures, total output, mining employment, employment effect, mining income, and total income would decrease by about 10%.

Annual costs for water treatment and reclamation for all federal mining operations are $423,000 and $30,600 respectively. Administration and enforcement of the Surface Management program for placer mining will cost the BLM and the COE approximately a total $23,400 annually (all values in 1987 dollars). Costs for State and private mines were not estimated because BLM has no regulatory authority for these operations; however, water treatment and reclamation costs would probably be similar to the costs for federal mines.

2.5.3 Alternative B

The effects of this alternative are based on 25 State and private mines operating continuously for the next ten years. There would be no further placer mining on federal claims. Effects under this alternative would be the same except for the following differences.

Cessation of mining on federal claims would end further short- and long-term impingements upon topography of the public lands.

Gold resources would remain undeveloped on public lands.

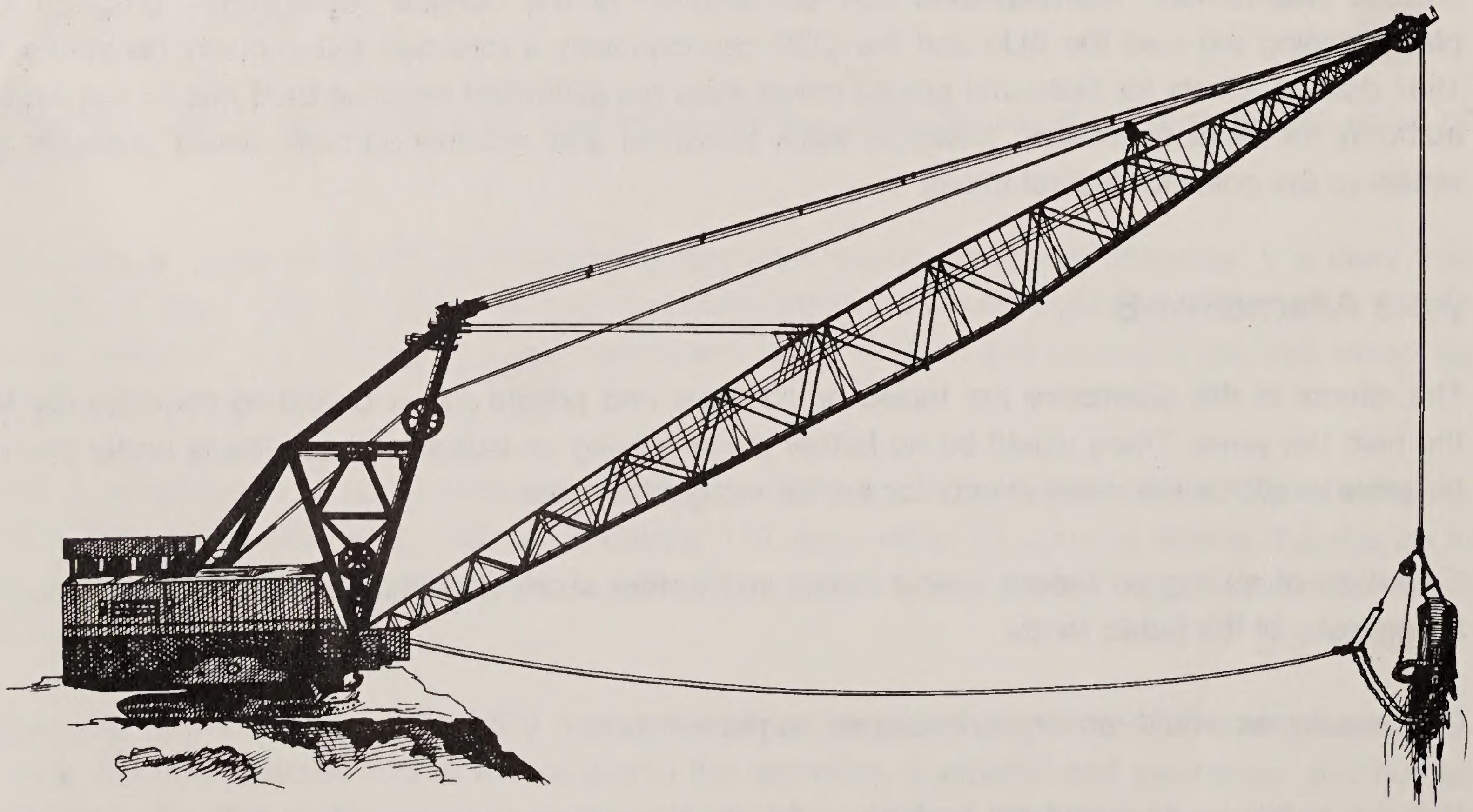
Soils on public lands would not be further disturbed by mining. Mining on non-federal lands would disturb the soil profile on 391 acres.

The impact of placer mining on water quality would be less than that described in the Proposed Action. The estimated soil loss from the watershed due to erosion and non-point sources would be 13,123 tons per day.

There is a long-term unavoidable loss of over 3,640 acres of the vegetation cover in the area from historic mines and roads. Activity on State and private lands would result in 72 acres of shrubs regrowing within 30 to 50 years, and 43 additional acres regrown to shrub in 50 years, 450 acres remaining barren or sparsely vegetated.

Approximately 4,602 acres of upland riparian wildlife habitat would remain physically altered because of past mining related activities. Continued mining on State and private lands would result in the physical alteration of 575 acres. Periodic disturbances to wildlife due to the operation of mining vehicles, machinery, and human habitation at State and private mines would result in 42,814 acres being subject to short-term adverse effects in localized areas during the mining season. The principal long-term adverse effect of past mining would be the unavoidable loss of approximately 3,750 acres for 40 to 50 years. The long-term cumulative loss of habitat to mining activities in these areas may contribute to a slight reduction in moose population potential.

The overall cumulative effect of total suspended sediment in the Minto Flats watershed attributable to State and private mining cannot be determined. Impacts to fishery resources would be less than those discussed in the Proposed Action. The Tolovana River would be impacted the least by no mining on federal claims because there are only a few State and private mines projected in this drainage.



Dragline

As described under the Proposed Action, certain subsistence uses would continue to be significantly restricted even if no mining were to occur on federal lands, or even if no mining occurred at all in the entire drainage. This is due, as noted, to ongoing impacts in part related to past mining. However, under this alternative, with no mining on federal claims, there would be no further active contribution of sediment caused by mining (although a minimal amount may anyway as judged by the 1987 mining session) to further add to the condition of an ongoing significant restriction already occurring in the area.

Impacts to recreation opportunities and visual resources would be less than those anticipated in the Proposed Action.

Mining expenditures, total output, mining employment, total employment, mining income, and total income would decrease by 44%.

Validity exams on all properly filed federal claims would cost the BLM approximately $1,730,000 to complete, and the estimated net present value of all the federal claims within the watershed is between $10,380,000 and $289,775,000 (Appendix B-3).

Components	Past Pre-1981	Present 1987	Proposed Action 1998
Number of Mines	Unknown	30	37
Acreage Disturbed	3,742	260	851
Acreage Reclaimed	Unknown	55	168
Topography	NSI*	Minimal impacts	NSI
Minerals	NSI on development	NSI on development	NSI on development
Soils:			
-Acres of soil disturbed	3,742	260	851
Water Resources:			
-Channel morphology miles	Unknown	7.5	9.25
-Sediment load tons/day	Unknown	13,070	13,220
-Toxic substances	Unknown	Unknown	Unknown
Landcover:			
-Permanently barren from mining	3,181	209	651
-Years to regrow to shrub community	50	50	30-50
-Threatened & endangered plants	Unknown	None perceived	None expected
Wildlife:			
-Acres of habitat permanently lost	Unknown	250	350
-Acres of habitat disrupted	Unknown	15,060	18,574
-Acres of habitat lost for x years	561 ac/unknown yrs.	611 ac/30-50 yrs.	761 ac/30-50 yrs.
-Acres of habitat physically altered	3,742	3,640	4,181
-Threatened & endangered animals	NSI	NSI	NSI
Fisheries: -Fish populations Chatanika	Unknown	NSI	NSI
Tolovana	Unknown	NSI	NSI
Goldstream	Unknown	Significant impact	Significant impact
Cultural & paleontological resources	Mining created historical sites	No new sites discovered	No change in impacts
Subsistence	Significant restrictions to subsistence uses	Significant restrictions to subsistence uses	Decreasing significant restrictions to subsistence uses
Recreation & visual resources	Unknown	Minimal	1987 levels
Economics: Rural			Expenditures, output, employment, & income would change by about +23%
-Mining expenditures	Unknown	$658,000	
-Mining employment	Unknown	155 FTE	
-Mining income	Unknown	$230,000	

*NSI - No Significant Impacts **Based on gold value of $2 000/oz.

Figure 2-7. Comparison of pre-1981 impacts with those of the 1987 mining season and projected 1998 impacts under the Proposed Action and the alternatives, and Worst Case Scenario.

Alternative A 1998	Alternative B 1998	Worst Case Scenario**
27	25	270 mines operating annually
621	575	27,000 acres total mining disturbance (1,750 ac old tailings and 25,250 ac new disturbance)
378	0	3,850 acres to Proposed Action performance standards
NSI	NSI	No significant impact
NSI on development	No further mining on federal lands	No significant impact on development
621	575	27,000 acres cumulative disturbance
6.75	6.25	67.5 miles annual disturbance
13,128	13,123	23,025 tons per day discharge during extreme precipitation events
Unknown	Unknown	Magnitude unknown, heavy metal and petroleum products
364	460	19,170 acres
25-30	50	30 to 50 years
None expected	None expected	No significant impact
255	277	250 acres due to permanent roads
13,554	12,550	135,540 acres
818 ac/30-50 yrs.	676 ac/50 yrs.	27,000 acres for 30 to 50 years
3,800	3,917	27,250 acres total (roads and mined acreage)
NSI	NSI	No significant impact
NSI	NSI	NSI
NSI	NSI	NSI
Significant impact	Significant impact	Significant impact
No change in impacts	No further impacts	Some material may be lost although additional discoveries may be made
Decreasing significant restrictions to subsistence uses	Decreasing significant restrictions to subsistence uses	Continuation of a significant restriction to subsistence uses
Similar to 1987 levels	Similar to 1987 levels	Increased access, impacts to visual resources & water quality may reduce visitor use
Expenditures, output, employment, & income would change by about -10%	Expenditures, output, employment, & income would change by about -17%	Expenditures, output, employment, & income would change by about +800%, see Appendix B-4

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Chapter III
Affected Environment

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CHAPTER MAPS

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Introduction

This chapter profiles the environmental resources for the Minto Flats drainage. It is not intended to be an encyclopedic description, rather it discusses the physical, biological, social, and economic materials and conditions that would change under the implementation of the Proposed Action or an alternative, and thus may aid a reader in understanding the alternatives.

Three of the required elements (Areas of Critical Environmental Concern, farm land, and wilderness) listed in Chapter One (Section 1.7) were not discussed or analyzed in this chapter because such resources do not exist within the affected area. A fourth element, air quality, is only discussed here in the introduction.

There is currently no quantitative information on air quality for the Minto Flats watershed. Because there are few industrial operations or cosmopolitan centers in the area, it is assumed the only pollutant sources are fugitive dust from travel on gravel roads, forest fires, and localized smoke from cabins. Occasional large forest fires in Interior Alaska can cause short-term air quality problems such as reduced visibility and discomfort over large areas. In general, however, the air quality in the area is assumed to be excellent, on observational evidence. Under all alternatives there are no anticipated long-term or cumulative impacts to the air quality in the area. Very localized deterioration of air quality will occur in the immediate vicinity of internal combustion engines employed by mining operations and other activities. Dispersion of exhaust will quickly make levels of pollution undetectable.

General Considerations and Interrelationships Among Geology, Soils, and Sediments

The intent of this section is to briefly consider those geologic properties and controlling processes that occur at or near the earth's surface. The set of processes collectively known as erosion involve the detachment and transport of materials from place to place on and adjacent to the land surface. These processes are active in different areas and at different rates, depending on such factors as the mechanical strength of materials, climatic conditions, local geology and topography, and vegetation.

Erosion includes both the movement of products by the transport agents, and their temporary or permanent deposition. Water, particularly streams, is the most important transport agent. The products of erosion are transported in streams as dissolved load, suspended sediment, and bedload.

These natural processes have various effects. For example, continual natural erosion replenishes the stream gravels necessary for a viable fish habitat. However, some mining practices tend to enhance erosion processes. Accelerated erosion is caused by exposure of soil and by loss of vegetation cover, with a resultant decrease in the ability of the soil substrate to naturally regenerate. Additionally, deposition of the eroded materials may occur in places where it is unwanted and/or in excessive volumes, especially in streams where it can adversely affect downstream resources and uses. Disturbance or removal of permafrost may locally, enhance biological productivity, although such actions also encourage erosion.

Erosion may be divided into two general types, here termed surface erosion and mass movement.

Surface erosion refers to the movement of individual soil particles in response to gravity and/or fluid flow.

These processes are usually minor in vegetated or undisturbed lands, although storm spikes or snowmelt runoff may overwhelm the ability of the land to accommodate the water and temporarily increase surface erosion. Surface erosion becomes important when land is disturbed either by nature (wildfires, landslides) or by human activities such as mining or road construction.

Mass movement is a general term for a group of processes by which a fairly large volume of earth is moved at various rates of speed under the influence of gravity. Rates of occurrence and velocities are usually increased by the presence of a fluid. Mass movement is generally caused by long-term weathering and reduction of strength, but individual occurrences are usually caused by environmental events such as heavy rainstorms.

Under natural as well as disturbed conditions, mass wasting processes are, in the short-term, the most significant means of erosion in terms of environmental considerations.

General Soil Properties

Soil characteristically consists of a layer of organic material underlain by several layers or "horizons" of mineral soil. The properties of each horizon vary as a result of the interplay of soil-forming factors: in particular climate, vegetation, and topography. These act on the parent material over time.

Weathering of rock-forming minerals at the earth's surface is the first step in soil formation. Chemical weathering and physical weathering form the more stable clay minerals, concentrate iron and aluminum oxides, and release the major plant nutrients such as potassium, phosphorus, and sulfur. This contributes to the solute composition of the soil water, and ultimately of groundwater and streamwater.

Soil physical properties control the drainage and availability of soil, water, and air to the root zone, affecting both root growth and nutrient movements. Physical soil properties include texture, structure, and density. Texture refers to the relative abundance of sand, silt, and clay-sized particles in the soil, and is often used as an approximate indicator of potential vegetation productivity. Structure is the spatial arrangement and bonding together of soil particles, and is important to drainage, aeration, and erosion resistance. Density refers to the soil's relative compactness, and is important to root distribution and water retention.

Vegetation and related soil biological processes are important to the development of soil physical properties. Development of soil organic matter contributes to water-holding capacity, maintains aggregate stability, and improves soil resistance to erosion. This organic matter is a main energy source for the micro- and macroorganisms that play an active role in controlling both chemical and physical soil properties. Any change in the quality or quantity of vegetation, air temperature, water regime, or a host of other environmental variables will cause a change in soil physical properties.

The most direct changes to physical properties caused by mining practices are probably compaction or change in the soil's bulk density, and direct disruption of the structure.

Soils are generally composed of some 15 chemical elements. Of these, seven (iron, calcium, potassium, magnesium, phosphorus, sulfur, and manganese) are important plant nutrients derived from soil weathering.

Soil chemical properties can be affected by any mining practice that tends to change the dissolved ionic composition of the soil water. Of particular concern are removal of nutrients or losses which exceed replenishment, as well as persistent changes to processes that control rates at which soil nutrients are made available to plants.

Soil biology generally refers to the organisms that inhabit the soil. Most contribute to beneficial processes such as weathering of parent material, soil aggregation, organic matter decomposition, nitrogen transformation and fixation, retention of other substances that would otherwise be lost by leaching, and protection of roots from pathogens.

Growth and activity of soil organisms are affected by water, temperature, aeration, acidity, food supply, and biological factors. In undisturbed lands, populations of soil organisms reach a dynamic equilibrium; seasonal changes occur, but annual populations are relatively stable. Major site disturbances upset this equilibrium.

Human activities such as mining practices, as well as various natural events may affect these processes through physical soil disturbance and modification or removal of vegetation.

3.1 Geology and Topography

The watersheds of Goldstream Creek, the Chatanika River, and the Tolovana River collectively comprise the major drainages which enter Minto Flats. The study area thus defined lies within the Circle, Livengood, and Fairbanks quadrangles, as mapped at a scale of 1:250,000 by the U.S. Geological Survey (USGS).

Much of the following discussion is based on and/or has been freely excerpted from several key references. Principal sources include "Administrative Report on the Mineral Resource Assessment for Part of the White Mountain National Recreation Area, Alaska," prepared for the BLM by the U.S. Geological Survey (USGS 1987a); "Mineral Assessment of the Lime Peak-Mt. Prindle Area, Alaska" (ADGGS 1987); "Alaska Regional Profiles: Yukon Region," (Selkregg 1974); "The Alaska Mineral Resource Assessment Program: Background Information to Accompany Folio of Geologic and Mineral Resource Maps of the Circle Quadrangle Alaska" (USGS 1987b); maps and text of USGS Open File Report 83-170-A,B,C (USGS 1983) on the Circle Quadrangle; and USGS Bulletin 872 (Mertie 1937). These references include extensive lists of previously published information, and should be consulted for this purpose, as well as for more detailed discussions of the geology, topography, and mineral resources of the study area.

Major portions of the principal drainage systems within the study area lie within the Yukon-Tanana Upland physiographic province, which is in east-central Alaska, bounded by the Yukon and Tanana Rivers. The study area also includes the relatively low lying, marshy Minto Flats, toward which these principal streams flow in a generally southwest-west direction. The Minto Flats are considered to be part of the Tanana-Kuskokwim Lowland physiographic province, a broad alluvial lowland of generally subdued topography. The Tanana River lies south of the study area and has been diverted northward in stages over a large area in which it meanders tortuously. This diversion likely is due to the influx of extensive deposits of glacial and glaciofluviatile material into the Tanana valley from the south by large glacial steams draining the north side of the Alaska Range. This northward arc of the Tanana River may also, at least in part reflect and be controlled by structural trends in underlying bedrock. The Tanana River has been unable to effectively transport this sedimentary material downstream and has thus deeply aggraded its valley, and by thus raising the baseline of erosion it has caused its tributaries from the north (Tolovana River, etc.) likewise to aggrade their valleys (Mertie 1937). This geomorphic-sedimentologic situation has probably persisted for an appreciable amount of time, perhaps since the onset of the Quaternary, or even earlier, in the geologic history of the region.

It has been suggested that the Minto Flats area is presently undergoing and/or has recently undergone uplift-upwarping directly due to tectonic activity, and/or "rebound" effects related to geomorphic and/or structural causes elsewhere in the region. Lack of substantive data preclude confirmation or denial of this hypothesis. Evidence does indicate, however, that this is an area dominated by "extensional" tectonics, with geophysical evidence of appreciable thicknesses of unconsolidated/semi- consolidated sediments underlying the present site of Minto Flats and the adjacent Tanana lowland.

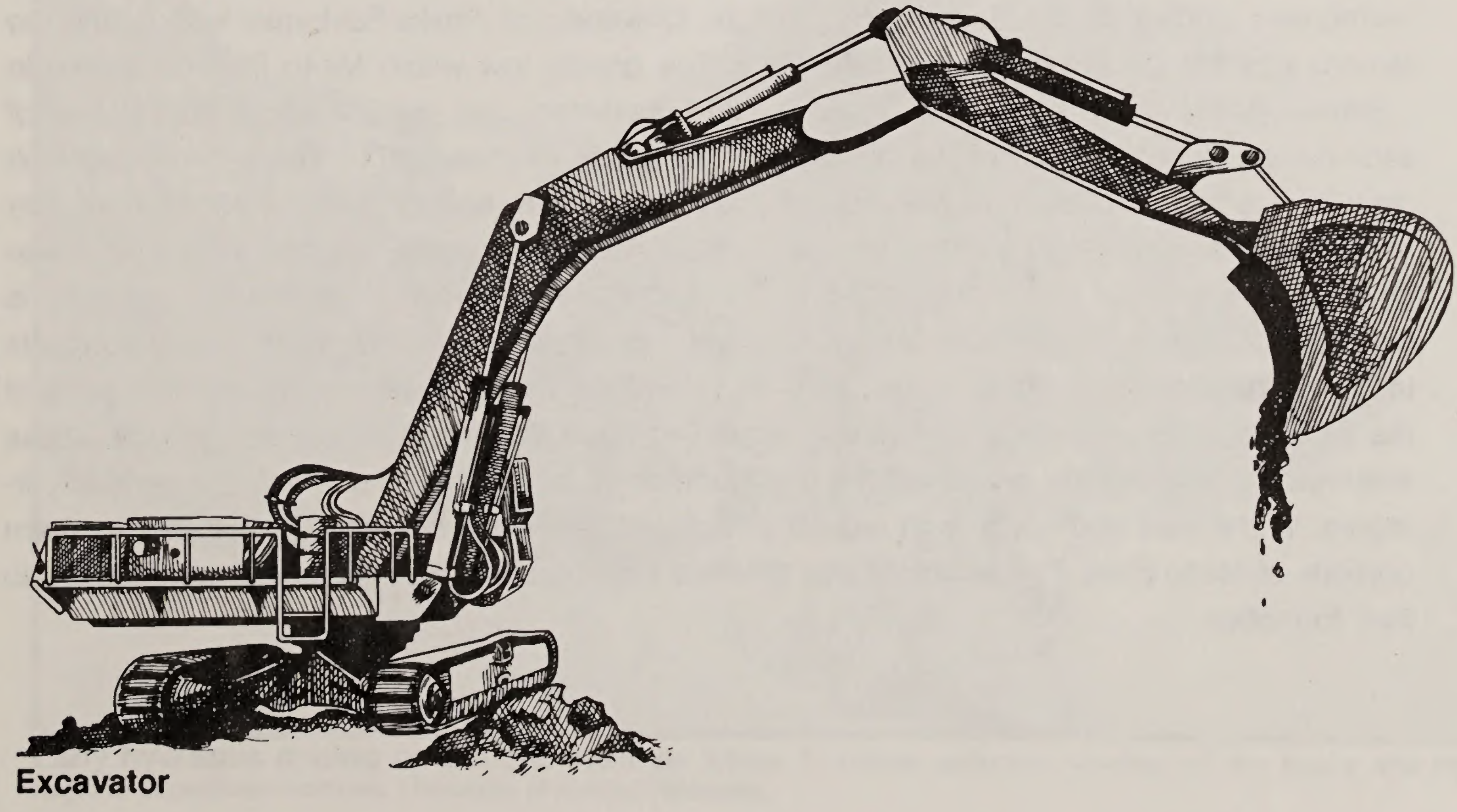
Barnes' (1971) discussion of a geophysical anomaly, a profound gravity low, at the Minto Flats area includes several particularly relevant comments.

> "...Physiographic evidence (D.M. Hopkins, oral communication 1961), strongly suggests that the Minto Flats are actively subsiding, and that sediments are accumulating there at the present time.... Thus the thickness of the sedimentary section in Minto Flats could range from one to several kilometers.... The suggested configuration assumes a layer of low-density alluvium overlying a thicker, intermediate-density, section which is separated from the basement rocks by a normal fault....
>
> "Some conclusions regarding the age of the deeper deposits beneath the Minto Flats may be drawn from the rather large thickness required to explain the gravity anomaly. The maximum thickness of Quaternary alluvium that has been measured in the Tanana Valley is about 250 meters at a seismic station two miles south of Fairbanks, measured by the author in 1952. Williams (1960) reports that about 120 meters of alluvium at Fort Yukon are underlain by late Tertiary deposits. Even a one km sedimentary section would thus be considerably thicker than nearby deposits of Quaternary alluvium, and even one km of subsidence during Quaternary time would represent a rather rapid crustal movement. Accordingly, older Tertiary deposits are probably present in the deeper part of the Minto Flats basin. These Tertiary rocks are probably denser than Quaternary alluvium so the thickness of the section required to cause the anomaly

> is probably greater than one km. The subsidence which created the Minto Flats basin may have begun at about the same time as the subsidence and faulting that created nearby basins in which Tertiary sedimentary rocks are now exposed. Extensive Tertiary deposits are present both north and south of the Minto Flats in the Alaska Range (Wahrhaftig 1958) and along the Yukon River between the Yukon flats and the Palisades (Eakin 1913). Coal- bearing rocks are present in the lower parts of both the Alaska Range and Yukon Valley Tertiary sections, and may also be present beneath the Minto Flats. Gravity values at the southern end of the Minto Flats anomaly are lower than in other bordering areas and suggest that the sedimentary prism may have a shallow connection with one of the basins containing Nenana gravel."

Shepherd and Matthews (1985) describe the Flats as follows:

> "Minto Flats is a relatively low-lying area with elevations from 300 to 350 feet above mean sea level. The slight rises in elevation consist largely of sand dunes, a northern extension of vast dune areas to the south. An exception to the general low topography is a peninsula-like intrusion of higher ground extending from Livengood to C.O.D. Lake, bounded on the west by the Tolovana River and on the east by the Tatalina River.
>
> "Drainage of the area consists of five major streams: the Tolovana River, the Chatanika River, Goldstream Creek, Washington Creek, and the Tatalina River. Goldstream Creek presently flows into Little Goldstream Creek and thence into the Chatanika River, Tolovana River and finally the Tanana River. Most of these river systems have high banks that are well defined and are usually above high water. Ice jams and extreme high water will completely inundate these banks.
>
> "Minto Lake is located in an area often flooded for long periods. The inlet of the lake was once the main channel of Goldstream Creek, but the channel became closed with hydraulic mining muck between 1929 and 1951. During this period Goldstream Creek converged its channel with that of Little Goldstream Creek. Minto Flats drainage is dependent on Tanana River water levels,



Excavator

which when high hold back runoff from the flats. Often during spring high water the flow of water reverses and enters Minto Lake. On years of lower snowfall and precipitation, this well drained lake system gradually becomes shallow and nearly dry. The same effect can be noted in the lower Tolovana flats near new Minto village....

"Many lakes, both large and small, oxbow lakes, and small potholes are scattered throughout the Flats. Some are not connected by channels to any of the drainage systems. The depth and acreage of these water bodies varies from year to year, or even during one season. Continuity of water in these water impoundments is directly dependent on annual flood waters. Some years there are few distinct lake or pothole shorelines, except those located in slightly higher terrain....

"Little geological field work has been attempted in Minto Flats except that which is presented in surficial mapping (Pewe, et al. 1966). Most of the surface deposits at Minto are composed of flood plain alluvium, swamp deposits, and abandoned flood plain alluvium. Scattered throughout the flats are some low sand hillocks formed from material deposited in the early Pleistocene. In some areas along the hills to the east and west are patches and extensive areas of perennially frozen silts, roughly of the same geologic period. Higher elevations show typical deposits of Fairbanks loess. On ridge tops, down to approximately 1,000 feet in elevation, Birch Creek schist is the prevalent exposed surface. These rocks are most prominent along the eastern edge of Minto Flats ... (Barnes 1971; p. 83)....

"An array of physical and natural factors led to the present habitat configuration of Minto Flats. These began with the geologic and tectonic formation of the Minto basin and continue with subsequent natural and introduced sedimentation of the area. Climatic as well as hydrologic forces have shaped the physiognomy and evolution of Minto Flats habitat....

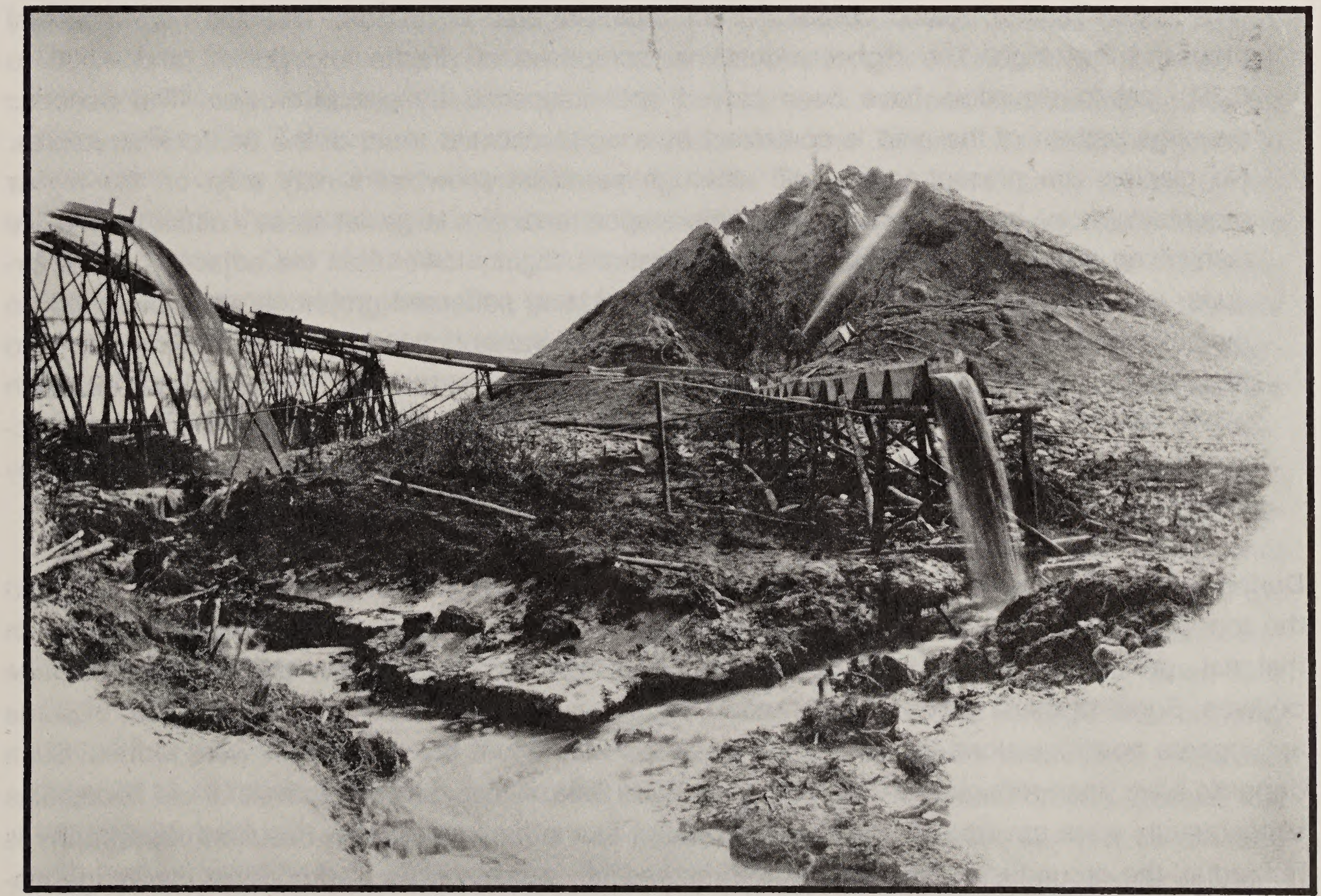
"Wolff (1982) suggests that gravity surveys by D.F. Barnes of the U.S. Geological Survey and earthquake studies by the Geophysical Institute, University of Alaska-Fairbanks help define the structure of the basin underlying Minto Flats. The gravity low within Minto Flats is shown in ...Barnes (1971). A cross section of the area is presented...and depicts about 10,000 feet of sedimentary deposits, both of Recent and Cenozoic age (Barnes, 1971). The pronounced fault shown...is a few miles west of Nenana and follows along the eastern limits of Minto Flats. The Minto basin is also fault-bounded on the north. Recent earthquake records show that these faults continue to be active (Wolff 1982). Tectonic movement along these faults generally is credited for causing land subsidence over several portions of the flats. Wolff (1982) suggests upon examination of topographic maps of the Minto Flats that the eastern and northern parts of the flats are in an active and tectonically controlled basin undergoing rapid subsidence. These assumptions are partially based on the configuration of lake shorelines, which are generally irregular to the east and north, with regular and round shorelines over the central and southern portions of Minto Flats. This indicates that different physiographic and geologic processes led to their formation.

> "These subsidence areas are bisected by the Tolovana River in the northwest and formerly by Goldstream Creek in the east. A northward trending loop of the Tatalina River gives further credibility to the subsidence theory. In turn, so does the fact that Goldstream Creek once flowed into Minto Lake. These subsidence areas serve as giant settling ponds for suspended solids, since water velocities through them are extremely low."

The alluvium-floored flats are dotted with numerous lakes and swamps, the remnants of former water courses. There are occasional low hills, probably vestiges of earlier gravel sheets, and/or dune and bar relicts of previous specific sitings of the Tanana River within the valley.

The Minto Flats area is bounded on the north by a highland rim which, in general, rises rather steeply from the plain. This escarpment, in many places at least, seems to be the result of normal faulting - extensional tectonic effects recognized in the region.

The adjacent Yukon-Tanana uplands province is a region of rolling upland characterized by discontinuous groups of higher mountains which surmount a terrain pervaded by ridges of more or less uniform height. The intervening valleys likewise lack uniformity in topographic character. Some headwater streams have narrow, canyon-like valleys, while others flow in wide open valleys which seem disproportionately large in comparison with the streams which presently occupy them; other streams flow across aggraded headwater plains. Similar diversity exists in their lower courses as



Early hydraulic mining operation. From the Wilson F. Erskine collection. courtesy of the Alaska and Polar Regions Department Archives, University of Alaska. Fairbanks.

well. Some of the lower valleys are broad aggraded lowlands, and others are narrow gorges. This marked topographic diversity is the result of a long and complex geomorphic history, which dates back to the Tertiary period (Mertie 1937).

The highland areas are the result of differential erosion of diverse bedrock types, juxtaposed structurally in moderately complex fashion; differential uplift/warping has been an accompanying influence in shaping the present land surface. There is a prominent regional geologic-topographic "grain" in a roughly northeast-southwest direction across the upland province, and the major ridges and valleys have a marked synonymy with this. These general trends are interrupted in places by isolated mountains associated with intrusive bodies of resistant granitic rocks and probably to attendant local uplift as well. Local relief is often quite pronounced. In the study area the higher elevations include Mt. Prindle (5,286 feet), VABM McManus (4,184 feet), VABM Beaver (3,120 feet), Sawtooth Mountain (4,494 feet), Tolovana Hot Springs Dome (2,386 feet), Amy Dome (2,317 feet), Wickersham Dome (3,207 feet), Pedro Dome (2,600 feet), Gilmore Dome (2,346 feet), Murphy Dome (2,930 feet), Ester Dome (2,364 feet), VABM Starve (3,145 feet), VABM Minto (1,394 feet), and Livengood Dome (2,622 feet). These prominences surmount more elongated ridges of approximately 1,500-3,000 feet, which in turn rise some 500 to 1,500 feet above adjacent valley floors.

Although these upland areas are neither exceptionally high nor areally extensive, there is evidence of Pleistocene glaciation, particularly in the higher elevations. As summarized by Pewe, et al. (1967):

> "The Yukon-Tanana Upland consists of an extensive area of rounded hills and ridges several thousand feet high. The higher mountains, comprised of granite and gneiss, and 4,000 to 6,700 feet in elevation, have been carved and steepened by glacial erosion. The dendritic drainage pattern of the area is controlled by a northeastward trend of the bedrock structures. No glaciers are present today, and although perennial snowbanks may exist on the higher mountains, none have been observed. Altiplanation terraces - large flat areas - occur in step-like fashion on ridges and mountain tops, at elevations slightly lower than the adjacent glacial cirques. Active solifluction is common on the slopes, and patterned ground is well developed on the altiplanation terraces. Permafrost is present in the valley bottoms and north-facing slopes to depths as great as several hundred feet. ...Cirques, U-shaped valleys, moraines, and outwash plains, all of two distinct geomorphic ages, indicate that at least two major alpine glaciations occurred in the Yukon- Tanana upland of Alaska. Although several hundred cirque and valley glaciers were present during each glaciation, only 3 to 5% of the upland was glaciated."

During the Pleistocene large volumes of water discharged from these mountains glaciers modified the topography at lower elevations, by erosion as well as deposition. Large amounts of outwash material, principally gravels, were deposited in low- lying areas, particularly along principal drainage courses. Some of these gravels contain economically valuable minerals, in particular gold; in some appropriate positions along the drainages natural concentrations placer deposits were formed. Such deposits have been recognized throughout the study area. These outwash gravels of old floodplains subsequently were covered by reworked silt, loess, and organic materials. Resultant topography is rather flat, the ground is poorly drained, and is presently partially frozen, with visible ice-wedge features in many places. Such permafrost conditions are pervasive throughout the Yukon-Tanana

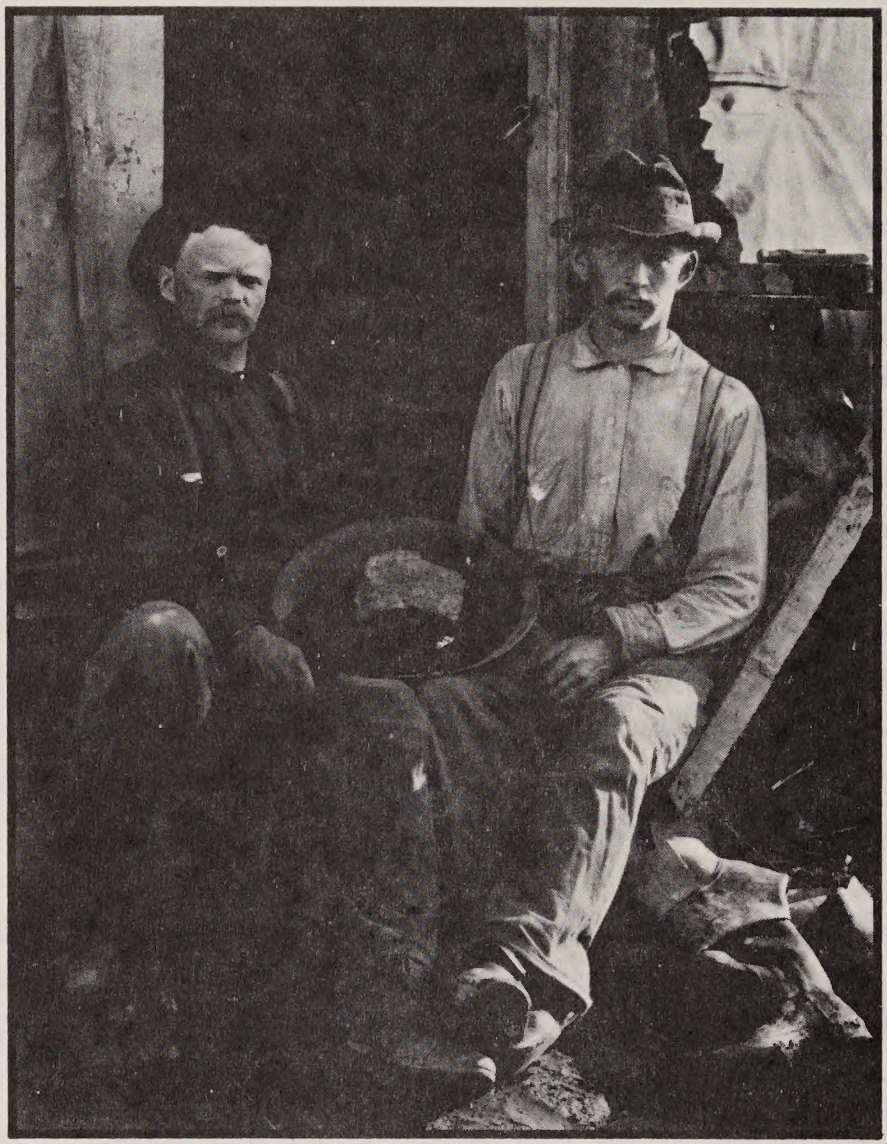
Upland since the entire Interior Alaska region is within the zone of discontinuous permafrost (Williams 1970). Specific relationships to permafrost in any given site depend on a complex array of geologic and topographic factors.

The Tolovana River headwaters are some 60 miles (direct map distance) northwest of Minto village, adjacent to the western border of the White Mountains National Recreation area. Peaks in the headwaters reach elevations of 3,120 feet (VABM Beaver). Major tributaries include Bridge Creek, Wilber Creek, McCord Creek, Livengood Creek, Lost Creek, West Fork of Tolovana River, Starvation Creek, Goose Creek, and Tatalina River. The West Fork of the Tolovana River has its headwaters in an area 15-20 miles directly northwest of Minto village, with peaks in this area reaching 4,494 feet (Sawtooth Mountain). Minto village lies at an elevation of 660 feet. The upper reaches of the Tolovana River system enter a northerly-projecting segment of Minto Flats, at an elevation of approximately 500 feet, several miles south of the settlement of Livengood and some 28 miles northeast of Minto village. From this point, the Tolovana River flows in a highly meandering fashion along a very low gradient to its confluence with the Chatanika River, some six miles south-southeast of Minto Village. The relatively flat valley of this reach of the Tolovana is up to five miles wide, with adjacent uplands ranging up to 2,386 and 2,231 feet, respectively, on the west and east sides of the valley. Thus, the terrain changes from semi-mountainous in the upper reaches to essentially flat in the lower reaches.

Mertie (1937) describes the lower reaches of the Tolovana as follows:

> "The lower Tolovana Valley is perhaps the most striking of the lowland features of this region. Debouching from the hills, the Tolovana and its parallel tributary, the Tatalina River, flow into valleys five miles or more in width, through which they pursue a tortuous meandering course for many miles. The Tolovana is a much larger stream than the Tatalina, but both are small in proportion to the size of the valleys that contain them. The valleys were surely carved by ancient streams that possessed both higher gradients and a larger supply of water than the present streams. One of the characteristic features of these streams in this portion of their courses is the presence of log jams. One great log jam in the Tolovana Valley has dammed the river for many miles upstream, and below this jam the bed of the river for miles is a mass of interlaced logs, from which many snags project upward to the surface of the water. At most places a 12 foot pole passed between logs will find no bottom.
>
> "A little farther downstream the Tolovana swings abruptly westward into the aggraded lower valley of Uncle Sam Creek and, returning to its own valley, is joined by the Chatanika River, into which the Tatalina empties a few miles upstream. From the mouth of the Chatanika to the Tanana the Tolovana River is a sluggish amber-colored stream that meanders even more tortuously than farther upstream, though in arcs of larger amplitude. The water is confined to a single very deep channel, and at normal stages of water the current is so slight that in many places it is imperceptible. In this stretch the valley opens to a maximum width of 25 miles and consists of a timbered silt plain, dotted with lakes, swamps, and marshes. Brooks crossed this swampy lowland with a pack train in the late fall of 1902, but earlier in the summer its passage with horses could be accomplished only with great difficulty and delay. The aggradation of this great silt plain by the Tolovana and its tributaries has been caused, as previously stated, by the

> elevation of the regional baselevel of erosion, due to extensive alluviation of the Tanana Valley with glaciofluviatile deposits. The great width of this plain, however, is another of the striking and unexplained topographic anomalies of the region."



Record nugget produced from early mining activity. From the "Toni" Troseth collection, courtesy of the Alaska and Polar Regions Department Archives, University of Alaska, Fairbanks.

The Chatanika River rises from headwaters in the Mt. Prindle and VABM McManus area, adjacent to the White Mountains National Recreation Area and the north unit of the Steese National Conservation Area, some 100 miles (direct map distance) east-northeast of the village of Minto. In its upper-mid reaches, the Chatanika parallels the Steese Highway to the settlement of Chatanika, flowing generally west-southwest. At this point it is joined by Cleary Creek and continues its westerly course along a somewhat broader (one to four miles wide) valley, north of Pedro and Murphy Domes, entering the eastern part of Minto Flats at an elevation of approximately 350 feet, some 24 miles southeast of the village of Minto. The Chatanika River then continues to flow at a very low gradient, meandering across the marshy, lake-dotted flats to its confluence with the Tolovana River, about six miles south-southeast of Minto Village. Major tributaries to the Chatanika River in the upper reaches include McManus Creek, Montana Creek, Idaho Creek, Faith Creek, Pool Creek, Smith Creek, Horse Creek, and Sourdough Creek, and numerous smaller tributaries in the middle and lower reaches (Cleary Creek, Dome Creek, Vault Creek, Murphy Creek, etc.).

Goldstream Creek has its headwaters in the Cleary Summit area, near Pedro and Gilmore Domes, approximately 58 miles (direct map distance) east-southeast of Minto village. Goldstream Creek flows in a generally southwesterly direction along a valley ranging from one to three miles in mid-reach width, to its entry onto Minto Flats, at an elevation of approximately 350 feet, some 32 miles southeast of the village of Minto. Goldstream Creek continues to flow at a very low gradient, in a meandering to somewhat disordered manner, across the marshy, lake-dotted flats, in a generally northerly direction, to its confluence with the Chatanika River, approximately six miles downstream from the point at which the Chatanika River enters Minto Flats. Principal tributaries of Goldstream Creek include Pedro Creek, Gilmore Creek, and Fox Creek in the upper reaches, with numerous tributaries in the middle-lower reaches (e.g. Big Eldorado Creek, Cache Creek, Ohio Creek, etc.)

Thus, principal drainage systems of concern in the present study share similar general characteristics in terms of regional physiographic and geohydrologic environments. The commonality is of streams originating in highland areas of appreciable relief, ultimately debouching into a broad lowland area at considerably lower elevation. Sediment loads picked up and transported by such streams in their more energetic upper reaches inevitably will tend to be deposited in reaches of lower gradient and sediment- carrying capacity. Thus, the Minto Flats area presently serves as a natural sediment trap wherein deposition and accumulation of fluvial sediments, with consequent aggradation, takes place as a natural geologic process. Locally, thermokarst phenomena also contribute fine-grained sediment as well. It is likely that a similar situation has existed in the general area of the Flats for some unknown but significant period of time during the geologic past, given the overall geologic-topographic relationships presently recognized in the region. General discussions of these types of processes are to be found in numerous references in the technical literature (e.g. Reading 1978; Allen 1970; Miall 1978).

The portion of the study area outside of Minto Flats is made up geologically of a variety of bedrock types which are juxtaposed structurally in a moderately complex manner. The principal disruptive structural features include major thrust faults, as well as strike-slip faults related to the Tintina Fault Zone. The Tintina Fault Zone is a very large-scale zone of faulting, of regional extent (hundreds of miles in surface-length), and of fundamental significance to the overall geologic framework of Interior Alaska. A portion of this zone extends along a northwest-southeast trend just north of the study area. The bedrock underlying the portion of the study area outside of Minto Flats ranges from Precambrian to Tertiary, and consists of quartzitic, pelitic, calcic, and mafic sedimentary and metasedimentary rocks, as well as some mafic and felsic metaigneous rocks. These have been extensively intruded by younger (Mesozoic and Cenozoic) magmas which resulted in the formation of appreciable amounts of granitic rocks, as well as minor amounts of intermediate and mafic igneous rocks.

Mertie (1937) discusses the general nature, distribution, and origins of the various Pleistocene - Recent surficial deposits recognized within the Yukon-Tanana Upland:

> "...earliest Pleistocene deposits consist of silt, sand, and gravel.... These deposits occur in many different sites in the present valleys. Some of them lie 200 feet or more below the present surface.... Others occur on stream terraces, well above the present valley floors. At some places they lie deeply buried in old channels, separated from the present stream channels by bedrock reefs; and at other places the old and the new valleys have nearly the same courses, so that the present streams are now dissecting the older gravel. Many of the richer gold placers in the Yukon-Tanana region occur in these older deposits....
>
> "These older deposits occur in all the principal mining areas of the region, including the Fairbanks, Hot Springs, Rampart, Circle, Seventymile, and Fortymile districts....
>
> "After the deposition of the older Quaternary gravel there began, in this region, a different type of sedimentation. Most of the older gravel deposits are overlain by a varying thickness of silt, containing much vegetal material. This silt is black when wet but is light to dark gray after the moisture has been removed.... Some evidence leads to the belief that a considerable part of this

material is wind-borne. At the top of such deposits, and locally in layers throughout them, the silt is mingled with much vegetal material, which gives it a black color; and locally beds of peat form a part of the sequence. These deposits of silt containing considerable vegetal material are called "muck" by the miners; but because all the silt is dark- colored when wet the term "muck" is loosely applied to all the dark-colored silts.

"These silt deposits, as well as the gravel below them, are usually frozen in whole or in part, in Interior Alaska. The silt, however, is much more likely to be solidly frozen than the gravel. It also contains beds and lenses of clear ice, practically free of sediment, which are believed in large part to have formed after the original deposition of this material. These beds of silt in some localities are only a few feet thick, but in other places, as in the Fairbanks district, they may have a thickness of 100 feet or more. The silt beds are not uniform in character throughout, for mining has shown the presence in them of inlaid lenses of grit or even gravel, showing that conditions of alluvial accumulations were by no means uniform, even at any one locality. Such deposits, overlying the older gold-bearing gravel, present one of the great difficulties of placer mining in Interior Alaska. The silt itself is practically barren of gold, and in order to reach the underlying placers this overburden must either be removed, or else underground mining methods must be utilized....

C.P. GIBS. OPEN. CUT. MINING ON. 5. BELOW PEDRO CREEK
Huey Fot.

Early Interior placer mining operation. Photo courtesy of Anchorage Museum of HIstory and Art.

"The Recent alluvial deposits are composed mainly of gravel, sand, and silt. Much of the coarser debris has been eroded from bedrock sources and laid down by the present streams. The silt has been derived in considerable measure from the reworking of the older silt, although a certain proportion has also been deposited by recent streams. Certain solifluxional processes peculiar to sub-Arctic regions have also tended to produce fine sediments of this type....

"Stream detritus originates largely by mechanical and chemical weathering of the regional bedrock, but in Interior Alaska the relative importance of these methods is modified by local conditions. Chief among these are low mean annual temperature and the vegetation. The mean annual temperature of the Yukon-Tanana region is about 23° F., which alone is capable of producing a condition of permanent frost in the subsurface. In addition to this, the valley floor and sides and also the ridge tops up to an elevation of 3,000 feet are covered with a mantle of mosses and other vegetation, which act as an insulator and tend to prevent the summer heat from penetrating far into the frozen ground below. And these two conditions combine to produce a curious disposition of the local precipitation, for the frozen condition of the deeper ground prevents deep circulation of water, and the mosses prevent a rapid surface runoff of the rainwater. Therefore, the moisture is conserved in a spongelike mossy mat close to the surface, where it favors the growth of vegetation much denser than might be expected in a region where the annual precipitation is only 11 or 12 inches.

"The customary distinction between the water table and the zone of weathering above the water table is in this region hardly valid, for much of the subsurface water, where present, is frozen. Hence the solvent and depositional effects of circulating ground water are almost lacking, and the chemical effects of oxygen and carbon dioxide are sharply restricted, because these reagents are not carried in solution. Chemical weathering, therefore, is much less important as an agent of weathering than in regions farther south.

"The surface of the ground in summer, however, is in a state of alternate thawing and freezing that produces marked mechanical weathering, due to the effects of frost heaving and related processes. The bedrock is loosened and fractured by the freezing and thawing of water,and an angular rubble that shows little oxidation is produced. This rubble tends to accumulate on the ridges as residual material. But the same thrusting forces that fracture and comminute the bedrock are also effective as a means of transportation, for the rock debris is thrust upward and laterally away from its place of origin and begins to move slowly down the hill slopes into the valleys below. Such moving sheets of alluvial material often develop characteristic flow lines along the sides of the valleys so that they resemble successive waves on a shallow body of water....

"Although chemical weathering in the headwaters regions of the streams is sharply restricted, and mechanical weathering is seasonal, nevertheless the total amount of debris that is moved by the processes above outlined is remarkably great. It is not uncommon to observe sheets of such alluvial material impinging from both sides of a valley upon a headwater stream at a rate faster than the stream can transport the material downstream, so that the stream tends to flow in a narrow channel, sometimes several feet deep and only a foot or two wide; and in places the lateral debris has actually coalesced over the running water. This residual and semiresidual

> material is unsorted and includes rock fragments of all sizes, embedded in fine silt. Where the alluvial sheet has moved laterally a considerable distance from its place of origin to a drainage channel, the angular debris becomes rounded to a considerable degree. As soon as this material is exposed to the effects of running water, it begins to move downstream, the silt rather rapidly, especially in times of flood, and the larger rubble more slowly. From this stage onward, however, the erosional processes are essentially similar to those that prevail in more southern latitudes, and the results are essentially the same. The headwater gradients are normally steeper than the gradients of the lower valleys, and at some point or rather some zone in the valley stream action changes from transportation to deposition. As the regional relief is reduced and the headwater gradients are diminished, this zone of deposition moves upstream, thus developing progressively upstream a fluviatile gravel sheet. As the upper part of the gravel sheet is extended upstream, finer sediments cover the lower part, with the final result that the coarser and heavier sediments form the base of the alluvial section. The uniformity of this process is interrupted by floods, which carry coarse material farther downstream than it would ordinarily go and deposit it on top of finer material, thus resulting here and there in alternating beds of fine and coarse material. This general process of stream alluviation is also modified by local conditions....
>
> "Another condition that modifies the character of the Recent alluvial deposits is the effect of winter ice.... In some of the smaller streams the ice increases greatly during the winter, both in thickness and in area, as a result of overflows of water, acting under hydrostatic pressure from upstream. Such bodies of ice do not move downstream in the spring with the normal winter ice but are dissected by the streams and often remain as valley ice, or "aufeis", nearly all summer. Such deposits of aufeis also have the effect of widening valley floors, for in spring, when the water first begins to flow, channels may be cut along the sides of the ice, thus diverting the stream against the valley walls and producing lateral erosion. Many stretches of wide flat valley floor on the tributaries of the Yukon have been produced in this manner, and it is quite possible that the same process, acting on a larger scale during the glacial epoch, may have been a powerful accessory factor in the development of the Yukon Flats."

3.2 Mineral Resources

The U.S. Geological Survey has investigated the geology and mineral resources potential of portions of the study area as part of studies of the Circle and Livengood quadrangles (USGS, 1983 and 1987b), while the State of Alaska has carried out related work in the Lime Peak - Mt. Prindle area (ADGGS 1987):

> "The geologic setting of the Circle quadrangle, especially the presence of post-orogenic plutons intruded into regionally metamorphosed rocks, is similar to regions, such as eastern Australia, southwestern England, northern New England, and southeastern Canada, that contains tin vein/greisen deposits, tungsten skarn deposits, lode gold deposits with associated placers, and uranium deposits hosted by peraluminous granites. The presence of very small bodies of

> ultramafic rocks would permit the occurrence of chromite, nickel, and asbestos deposits although supporting geologic and geochemical evidence for such deposits has not been found within the quadrangle." (USGS 1983).

Additional work by the State of Alaska (ADGGS, 1987) has further substantiated the potential for mineral deposits featuring tin, silver, tantalum, tungsten, uranium, rare-earth elements, and gold in bedrock environments in the Lime Peak - Mt. Prindle area. This study was consulted for overview of the headwaters of the Chatanika River and environs. Probabilistic estimates were made for lode mineral resource potential in this area by comparing various attributes of the observed geology, geochemistry, and mineralization with similar, well-studied mining districts worldwide. This methodology gives a range of potential resources at various levels of certainty. The results indicate that three- quarters of the potential mineral resource is in tin-silver deposits, and about one-quarter is in gold deposits. The quantitative estimates suggest a fair probability (50%) that the Lime Peak-Mt. Prindle area contains as much tin and silver as moderate-sized producing tin districts worldwide (320,000 tons of tin, and about 10 million ounces of silver - a gross metal value of $3 billion at current commodity prices). A small probability (5%) exists that the study area contains three times that amount of tin and silver. Approximately two-thirds of the tin-silver endowment is associated with six prospect areas in the Lime Peak pluton; the remainder of the endowment is distributed through other parts of the Lime Peak pluton, the Quartz Creek pluton, and the Mt. Prindle pluton. The bulk of the uranium and rare-earth potential is confined to the syenite intrusions at the western edge of the Lime Peak-Mt. Prindle area. At a 50% probability, the syenites would contain at least 250 tons of uranium and 520 tons of rare-earth elements (approximately $40 million current gross metal value). Lode gold endowment is mostly restricted to a belt along the southern part of the Lime Peak-Mt. Prindle study area, and is present primarily in quartz-tourmaline vein-associated occurrences and alkalic igneous rock-related deposits, with a small contribution from stratabound deposits and skarns. Most of the lode gold endowment potential is in large volume, low-grade, disseminated, and vein-aggregate deposits. Gold content of the favorable areas at the 50% probability level is equivalent to a large Alaska gold district (1.5 million ounces, $675 million current, gross metal value). A low probability (5%) exists that the ADGGS study area could contain ten times as much gold.

The U.S. Geological Survey has recently investigated the mineral resources potential of a major portion of the White Mountains National Recreation Area (WMNRA). A synopsis extracted, with minor modifications, from the resultant (USGS 1987a) report is as follows:

The potential mineral resources for a major portion of the WMNRA have been assessed using the concept of geologic deposit models. A deposit model is defined as the set of attributes common to a particular class of mineral deposit. Most of the deposit models considered can be found in USGS Bulletin 1693d (Cox and Singer 1986). The deposit models were used to identify areas within the WMNRA that exhibited features common to a particular model. The identification of each area was based on detailed geologic mapping, interpretation of geophysical and geochemical data, and examination of the known mineral occurrences. For each identified area, subjective estimates of the number of undiscovered deposits were made, and these were combined with grade-tonnage data for the respective model to produce estimates of the contained metal content. The assessment methodology used is described by Drew and others (1986) and is embodied in a computer program known informally as MARK3.

Subjective probabilistic estimates of the existence and the number of undiscovered deposits have been combined with grade- tonnage models for eight major deposit types (indicated to be present or possibly present) to produce estimates of the contained content for eight different metals and one non-metallic mineral within the part of the WMNRA assessed (USGS 1987a). Within this area, it is estimated that there is 46,000 oz. of gold, 4,200,000 oz. of silver, 310,000 tons of zinc, 180,000 tons of lead, 500 tons of tin, 2,100 tons of tungsten, 7,000 tons of thorium, and 6,000 tons of rare-earth oxides in undiscovered deposits. Overall, it is estimated that there is an expected 6,900,000 tons of undiscovered metallic ore-bearing material. For non-metallics, it is estimated that there are 27 billion tons of exceptionally pure high-calcium limestone. At the present time, significant undiscovered resources of chromium, asbestos, nickel, or diamonds are not predicted. A recent report of the occurrence of platinum in gold samples in the nearby Tolovana mining district makes platinum worthy of further consideration as a potential metallic resource.

One and one half Tons of Gold, Bricks and Dust.
Scene in Alaska Commercial Co's store in Dawson June 8, 1901
CLEAN GOLD
ACCO
SF

One and one-half tons of gold at the Alaska Commercial Co. store in Dawson, Canada, circa 1901. From the Lulu Fairbanks collection, courtesy of the Alaska and Polar Regions Department Archives, University of Alaska, Fairbanks.

A summary of the probabilistic estimates of the existence and the number of undiscovered deposits within the WMNRA for the indicated deposit types/commodities considered, was presented by the USGS (1987a). These deposit/commodity types are:

Tin greisen
Rare-earth elements
Tungsten skarn
Polymetallic vein
Lode gold
Placer gold
Sedimentary exhalative

For most of the deposit types, the probability that one or more undiscovered deposits exist is low. This is due largely to the overall lack of mineralization evidence in rocks exposed at the surface and the degree of weathering that has occurred. It is reasonable to assume that estimates of the existence and number of undiscovered deposits might be different if more were known about the subsurface.

Cobb (1984) discusses the Tolovana (Mining) District, which includes the Tolovana River watershed, as follows:

> "The Tolovana district is the area drained by southwest-flowing tributaries of the Tanana River from Dugan Creek on the west to the Tolovana River on the east. The drainage basin of the Chatanika River above the mouth of the Tatalina River is not included. The district is bounded on the north by an arbitrary line dividing the lowlands of the Yukon Flats from higher ground drained mainly by upper Beaver Creek.
>
> "Most of the district is in the Yukon-Tanana Upland and is characterized by broad even-topped ridges with an average summit elevation of about 2,000 feet above which elongate mountain masses rise 2,000-3,000 feet. In general the valley floors are wide and occupied by widely meandering streams. The lower part of the Tolovana River valley is a broad, low, lake- dotted, marshy area through which the main stream and the lower parts of its tributaries flow in tortuous channels. This part of the district is in the Tanana-Kuskokwim Lowlands province.
>
> "The southern part of the district, geologically an extension of the adjacent Fairbanks and Circle districts, is a metamorphic terrane of schists and related rocks of Precambrian(?) and early Paleozoic age. To the northwest these rocks are succeeded by northeastward-trending belts of slightly metamorphosed Paleozoic clastic, volcanic, and carbonate rocks and chert. Lower Cretaceous clastic rocks underlie an area in the western part of the district. Diorite, quartz monzonite, granodiorite, and granite plutons and dikes, mainly of Mesozoic age, are common in the district. A belt of serpentinite bodies of Devonian(?) age extends northeastward from Livengood for many miles. Evidence of more than one Pleistocene glaciation has been found on the higher peaks, but all are now ice free. The district is mainly within a zone of discontinuous permafrost;

> many south- facing slopes are not perennially frozen. The flats in the lower valley of the Tolovana River generally are underlain by moderately thick to thin permafrost and numerous isolated masses of frozen ground.
>
> "Lodes in the Tolovana district have been found only in the area immediately around Livengood and on Sawtooth Mountain about 30 miles to the west. They contain gold, silver, antimony, mercury, chromium, nickel, and iron. However, only small amounts of antimony ore from Livengood and Sawtooth Mountain and a little mercury from Livengood have been recovered from lode sources. One of the serpentinite bodies near the head of the Tolovana River contains abnormally large amounts of nickel and detectable platinum and palladium. Many of the placer cuts near Livengood have uncovered quartz and calcite veins that contain gold and sulfide minerals; similar veins have been found in nearby hills.
>
> "At least 380,000 ounces of placer gold (1.9% of the total for the State) has been mined from creeks in the area near Livengood. The most productive placers near Livengood are old buried stream channels, one of which was followed for about four miles, and stream placers in which gold from old channels was further concentrated. The gold and other heavy minerals, which include stibnite and cinnabar, were probably derived from the mineralized quartz and calcite veins that are common in placer cuts and the nearby hills.
>
> "Asbestos occurs in veinlets in serpentinite near the head of the Tolovana River. No mineral fuels are known in the district."

In addition, Cobb (1973) describes the Livengood area placer deposits:

> "The most important feature in the erosional and depositional Quaternary history of the Livengood area was the development of a mature surface that was largely buried by later sediments. The divide between Livengood and Hess Creeks shifted back and forth in response to successive stream captures. The richest placers were gravels representing old stream-channel material on what are now buried bedrock benches that the present streams have not completely exhumed. Some deposits in the beds of modern streams and residual placers near the head of a few creeks that drain Money Knob and Amy Dome have been mined.
>
> "The longest and richest old channel is on an extensive bench northwest of Livengood Creek that has been traced in drift mines, drill holes, and surface workings from opposite the mouth of Amy Creek to Livengood Creek below the mouth of Myrtle Creek. Near the settlement of Livengood, this channel was extensively dredged for several years and is still (1970) being worked on a small scale. Water was brought across the divide at the head of the stream from a tributary of Hess Creek. Bench deposits were mined on Olive Creek and on several northwest-flowing tributaries of Livengood Creek. Gold reported to have been mined from Myrtle Creek and other right-limited tributaries of Livengood Creek probably was reconcentrated from the Livengood bench deposit. Of the streams that have supported profitable mining, only Steel and Wilbur Creeks do not drain Money Knob or Amy Dome. Data on these creeks are scarce and the source of the gold in them is not known.

> "Many heavy minerals have been identified in concentrates from creeks in the Livengood area. They include magnetite, hematite, ilmenite, and limonite, abundant chromite and chrome spinel, and cinnabar, stibnite, and other sulfide minerals. Less common are scheelite and cassiterite, one or both of which have been found in Lillian, Ruth, Livengood, Steel, and Goodluck Creeks, monazite found in Livengood Creek, and a niobium-titanium-uranium-rare earth mineral found in Goodluck Creek."

Cobb (1984) discusses the Fairbanks (Mining) District, which includes the Chatanika River and Goldstream Creek watersheds, as follows:

> "The Fairbanks District is the area drained by the Chatanika River and northern tributaries of the Tanana River from Minto to and including Shaw Creek.
>
> "The district is within the Yukon-Tanana Upland except for isolated areas along its southwest border that are in the Tanana-Kuskokwim Lowland, and it consists of marshy flats along the lower courses of major tributaries of the Tanana River. Most of the district is a dissected plateau 2,000-4,500 feet in altitude that rises gently from west to east and is characterized by many wide valleys separated by broad rolling divides surmounted by rounded domes and a few mountainous areas that rise several hundred feet higher.
>
> "The oldest rocks in the Fairbanks District are a group of schists, crystalline limestone, quartzite, amphibolite, and gneiss of Precambrian and early Paleozoic age. These rocks were intruded by mainly Mesozoic plutons and dikes, most of which are granodiorite, quartz diorite, or porphyritic granite and quartz monzonite. Nearly all the domes and mountains that rise above the general upland surface are underlain by such rocks. Except for a few local cirque glaciers on the highest mountains, the district was not ice covered, but the Quaternary history of this periglacial area is complex. The uplands are generally covered by a blanket of loess derived (and still being derived) from the proglacial flood plains of streams issuing from the Alaska Range many miles south of the Tanana River. Loess mixed with locally derived clastic material and vegetation chokes valleys and forms the frozen muck that overlies most of the placer-gold deposits. Frozen tissues and skeletal remains of Pleistocene mammals are common in this material.
>
> "Most of the lodes in the Fairbanks District are concentrated in an area within about 25 miles of Fairbanks, though a few non-productive mines have been found elsewhere. Total lode production was about 239,250 ounces of gold, 39,000 ounces of silver, 2,500-3,000 tons of antimony ore, and scheelite ore and concentrates containing several thousand units of WO_3. In the vicinity of Fairbanks, gold lodes are near granitic plutons at Pedro and Gilmore domes northeast of Fairbanks and at Ester dome (where the pluton has not yet been unroofed) west of the city. The tungsten deposits (predominately scheelite) are principally in the Gilmore dome area. Lodes in other parts of the district appear to be in similar geologic settings. The precious-metal lodes are commonly in fissure veins, composed mainly of quartz that cut schist, usually near contacts with felsic intrusive rocks. The antimony deposits occupy the same lodes as the economically more important gold deposits. Sulfide and sulfosalt minerals are constituents of most of the veins. The tungsten deposits are in limestone lenses that were largely replaced by silicate minerals, in granitic and pegmatitic dikes, and in auriferous quartz veins.

> "The Fairbanks District has produced more placer gold than any other in the state, exceeding the total production of the Seward Peninsula region by well over a million ounces. About 7,650,000 ounces has been produced since 1902, when gold was discovered on Pedro Creek. This amount represents 37.2 percent of the total recorded Alaskan placer-gold production. Large dredges were first used near Fairbanks in 1928. Before that time high- grade deposits were worked mainly by drift mining and scraper plants after permafrost had been thawed with steam. Some of the deposits were very rich; for example, the average tenor of the gravel mined in 1908 was about $5.60 (gold at $20.67 per ounce) per cubic yard. The dredges worked lean ground that had been thawed with cold water and reworked areas that had been mined by other methods. Placer mining in parts of the district not close to Fairbanks accounted for between 100,000 and 200,000 ounces of gold.
>
> "The heavy minerals in the placers were probably derived from local lode deposits, as valuable placers were found only where lodes containing the same minerals were mined or prospected. Most of the placers in the district were stream placers that had been buried by more recent alluvium and loess that choked creek valleys; a few deposits on buried bedrock benches, however, were found during drift mining.
>
> "The nonmetallic mineral resources (other than material used for road metal, railway ballast, and decorative stonework) in the district consist of small bodies of limestone and deposits of clay possibly suitable for rough ceramic uses. None have been developed. No occurrences of mineral fuels are known in the district."

More detailed discussions of the mineral resources of the study area include Cobb (1973), and Berg and Cobb (1967), among numerous other contributions to the technical literature. Mertie (1937, pp. 251-261) presents an informative summary discussion of placer deposits, as does Cook (1983).

Cobb (1984) notes 34 streams in the Chatanika and Goldstream drainages having placer gold occurrences. These streams are:

Little Nugget Creek
Ready Bullion Creek
Sheep Creek
Our Creek
Treasure Creek
Wildcat Creek
Engineer Creek
Fox Creek
Flume Creek
Hill Creek
Monte Cristo Pup (Creek)
Rose Creek
Twin Creek
Big Eldorado Creek
Moose Creek
St. Patrick Creek
O'Connor Creek
Dome Creek
Vault Creek
Bedrock Creek
First Chance Creek
Goldstream Creek
Gilmore Creek
Melba Creek
Pedro Creek
Steamboat Pup (Creek)
Little Eldorado Creek
Willow Creek

- Wolf Creek
- Chatanika River
- Kokomo Creek
- Chatham Creek
- Cleary Creek
- Walnut Creek

Cobb (1984) lists 15 streams in the Livengood area which are known to have placer gold occurrences. These streams are:

- Alabam Creek
- Amy Creek and tributaries
- Franklin Creek (Gulch)
- Glen Gulch
- Lillian Creek
- Lucille Creek (Gulch)
- Olive Creek
- Wilbur Creek
- Willow Creek
- Ester Creek
- Gertrude Creek
- Goodluck (Lucky) Creek
- Livengood Creek
- Myrtle Creek
- Ruth Creek

3.2.1 Mining in the Study Area

The first documented discovery of gold in the Fairbanks area was by Felix Pedro in 1898. He returned to the area in 1901 and discovered profitable gold on Pedro Creek one year later. The towns of Fairbanks and Cleary quickly sprang up following the discovery and by 1903, population of the region reached 800.

Most people came to the region over a trail from Circle, via the Goodpaster River from Eagle and down the Tanana River. As mining increased and more miners arrived, the town of Fairbanks quickly grew and by 1906 its population had exploded to 8,000. This quick growth of people and services that were now available made Fairbanks the most important supply point in Interior Alaska.

Most of the gold in the Fairbanks area lay under a thick blanket of frozen overburden. The best, and possibly the only method of efficiently stripping this tremendous amount of overburden was by hydraulic methods. Water, either pumped or gravity fed, was used to wash away the overburden and them could be used to mine the pay gravels. One mining method that avoided removing the thick overburden layer was drift mining. Miners would tunnel through the overburden to the pay gravels, which were then mined and transported to the surface where they were run through a sluice box. Drift mining continued into the 1920's, until it gradually ended as the rich placer deposits were exhausted and became uneconomical to mine by underground methods.

Large gold dredges began to dominate the mining scene in the late 1920's when the United States Smelting, Refining and Mining (USSR&M) Company consolidated many claim holdings and began mining previously worked areas and lower grade ground. The first dredges for USSR&M Company began mining on Cleary and Goldstream Creeks around 1928 and within a few years the company had five dredges operating on these two creeks. In all, the company operated eight dredges in the

Fairbanks area, the last of which shut down in 1963. With the end of the big dredges, the placer mining industry around Fairbanks was almost dormant between 1965 and 1979. Interest in gold mining quickly returned when the price of gold increased to all time highs in the early 1980's.

Gold was discovered in the Livengood area in 1914 by Jay Livengood and Ted Hudson. The town of Livengood was quickly founded by hundreds of miners that arrived following the discovery and by 1917 there were 400 drift miners working in Livengood. Most of the early mining and gold production was from drift miners, although a few hydraulic operations did operate.

A floating dredge was brought to the area and began mining in 1940, but was later shut down during World War II. After the war, the dredge was again placed in production until 1955 when it sold and moved to the Koyukuk River. Mining continued in the area, but activity dwindled to low levels through the 1960's. Mining activity increased in the late 1970's and early 1980's due to the increased value of gold.

This brief glimpse of mining history was excerpted from a draft report by Hagler, Bailly and Company, which was prepared for BLM in December, 1987.

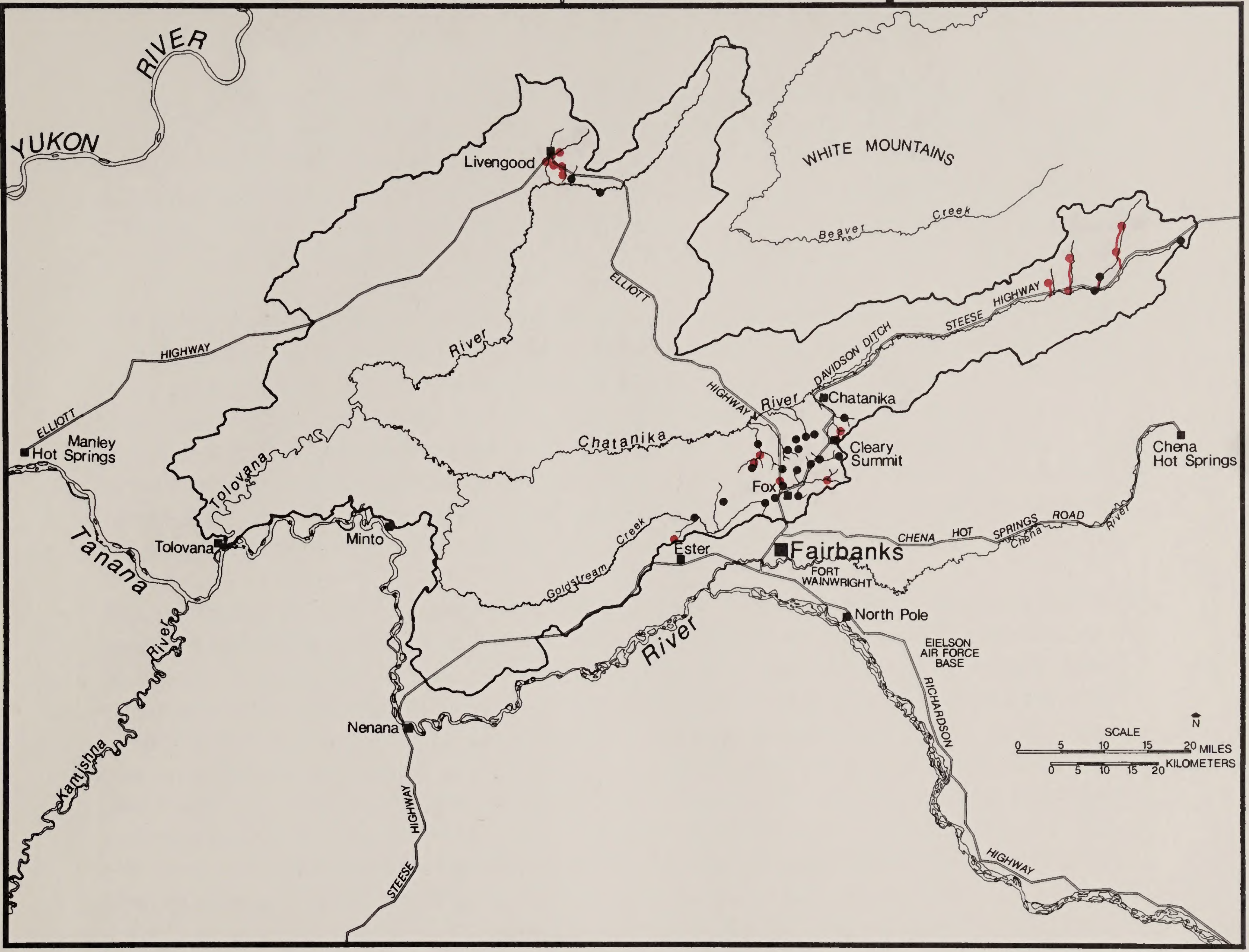
The most complex issue confronting the miner is compliance with State and EPA water quality standards. Two other issues affecting miners in the Minto Flats watershed are: 1) the permits the COE issues, and 2) the outcome of pending litigation and this EIS.

Moose

Water quality standards in some form have been in effect for placer mining for over ten years. EPA began issuing National Pollutant Discharge Elimination System (NPDES) permits in 1976 and has changed the permit requirements several times since then (Hagler, Bailly and Company 1987). Permits have required various mine effluent limitations for settleable solids and turbidity, and over the years requirements have become more stringent. Although water quality standards were in effect, enforcement of mining water discharge standards was nonexistent or minimal at best, and many miners operated without employing wastewater treatment techniques. By the early 1980's, it became obvious to the State of Alaska that water quality of mined streams was suffering and that the then current mining practices were not adequate to meet the water quality standards. To evaluate and attempt to resolve the problem, the Alaska Department of Environmental Conservation (ADEC) and other State agencies initiated numerous studies of placer mining's potential effects on the aquatic environment. They also sponsored projects to develop and field test wastewater treatment techniques.

One of the first field projects, a 1981 study on settling ponds, revealed that "the effluent from placer mines typically does not meet all State and federal water quality standards. The standards for turbidity and arsenic were almost never met and the standard for settleable solids was met with

Placer Mining Operations and Access Roads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RIVER
Livengood
WHITE MOUNTAINS
Beaver Creek
ELLIOTT
HIGHWAY
ELLIOTT
Manley Hot Springs
River
STEESE HIGHWAY
DAVIDSON DITCH
HIGHWAY
River
Chatanika
Chatanika
Cleary Summit
Tolovana
Fox
Chena Hot Springs
Tanana
Tolovana
Minto
Goldstream Creek
Ester
CHENA HOT SPRINGS ROAD
Chena
River
Fairbanks
FORT WAINWRIGHT
River
North Pole
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SCALE
0 5 10 15 20 MILES
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Legend

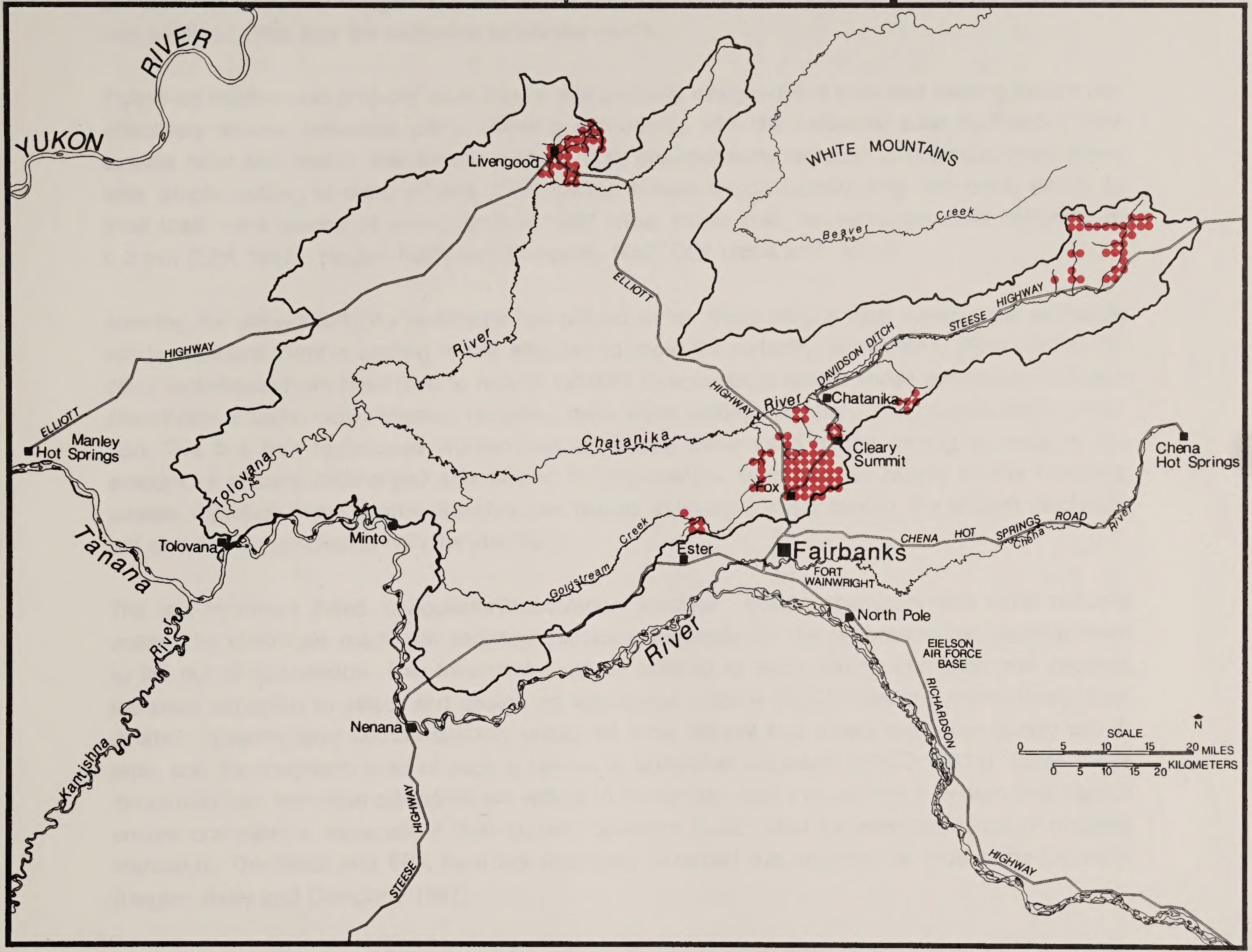
- 🟥 Federal 1987 operations*
- ● State 1987 operations*
- ⟋ Winter Access

*The operations depicted above include only those active State and Federal claims for which Annual Placer Mining Applications were filed for the 1987 field season.

LOCATION MAP

MINTO FLATS WATERSHED
YUKON RIVER
FAIRBANKS
ANCHORAGE

Placer Claims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Cleary Summit
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Manley Hot Springs
Tolovana
Minto
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Kantishna
Goldstream Creek
Ester
Fairbanks
FORT WAINWRIGHT
CHENA HOT SPRINGS ROAD
Chena
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Chena Hot Springs
North Pole
EIELSON AIR FORCE BASE
RICHARDSON HIGHWAY
River
Nenana
STEESE HIGHWAY
SCALE
0 5 10 15 20 MILES
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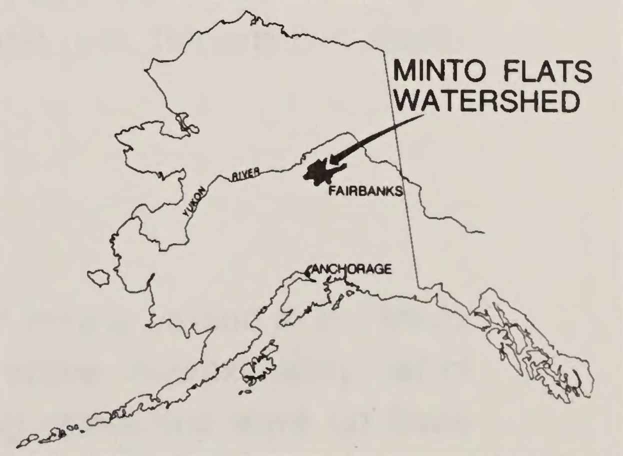
N

Legend

● Federal placer claims shown active on BLM records, but not actually operating in 1987. One dot may represent more than one claim.

LOCATION MAP


MINTO FLATS WATERSHED
YUKON RIVER
FAIRBANKS
ANCHORAGE

various degrees of success. The pH and temperature standards were met most of the time, and the standard for dissolved oxygen was met all the time" (ADEC 1982). Seven of the nine project mines with settling ponds met the settleable solids standards.

Follow-up studies and projects have shown that properly designed and operated settling ponds can effectively remove settleable solids, allowing compliance with the settleable solid standard. These studies have also shown that arsenic and mercury are effectively reduced to non-hazardous levels with simple settling of mine effluent (EPA 1987a). Miners began constructing and using ponds to treat their mine discharge water, and by 1987 most mines met the settleable solid limitation of 0.2 ml/l (EPA 1987a; Hagler, Bailly and Company 1987, DOI 1986a and 1987c).

Meeting the effluent turbidity limitations has proved to be more difficult than meeting the settleable solids standard. Simple settling is not effective to meet the turbidity requirement (EPA 1987a), so other techniques have been tried to reduce turbidity to acceptable levels. These techniques included classification, clean water bypass, recycling mine water, tailings filtration, and coagulation/flocculation. The first four techniques worked well to reduce water used in the mining process or the amount of effluent discharged and helped to improve the overall water quality of the receiving stream. Although these treatment techniques helped to improve water quality, the effluent discharge still was not in compliance with the standards.

The last treatment listed, coagulation/flocculation, involves mixing chemicals with mine process water. The chemicals react with sediment particles suspended in the process water, causing them to fall out of suspension. This treatment must be tailored to each mining operation and requires technical expertise to select and design an application system (ADEC 1987a). Unfortunately, flocculation systems have not consistently produced mine effluent that meets the water quality standards, and the long-term cost of such a system is somewhat uncertain (ADEC 1987a). Given these circumstances, few mine operators are willing to invest time and money into a system that cannot ensure compliance, especially if their current operation is not cited for noncompliance of turbidity standards. The State and EPA have not rigorously enforced this standard at most mine locations (Hagler, Bailly and Company 1987).

Beginning in 1988, the COE will require miners to obtain a permit for operations that discharge dredge or fill materials into waters and wetlands and/or that obstruct or alter these waters. This requirement is not new, but few miners have obtained these permits in the past. Reclamation standards may be similar to those currently required of federal operators.

3.2.2 Active Mines

There were approximately 40 mining operations proposed for the 1987 mining season in the Minto Flats drainage area and at least 75 percent of those operations were active. Approximately half of the proposed operations were on federal claims while the remaining operations were on State claims and private lands. Ten of the active mines were on federal claims. Locations of the proposed operations and associated access are shown on the Placer Mining Operations Map. The general locations of active federal mining claims are shown on the Placer Claims Map.

About 15 mines were active in the Chatanika drainage, with half of the operations on the upper reaches of the drainage along Faith and Sourdough Creeks. Most of the remaining mines surround Cleary Summit and Pedro Dome. The operations along Faith Creek tend to be larger in size, 15 to 20 acres in total disturbance, than the other mines in the drainage, which usually disturb less than five acres.

Approximately 12 mines operated in the Goldstream Creek drainage during the 1987 mining season and only two of these operation were on federal claims. Most of the operations are small (less than five acres), but three or four mines disturbed greater than 10 acres. Two or three of the 12 operations are mining lode deposits.

Seven mines, six of which are on federal claims, were proposed in the Livengood area. Most of the active mines disturbed around five acres; however, one mine has disturbed about 40 acres.

The majority of mines in the Minto Flats drainage operate in a manner similar to that described in Chapter 2.3. Most use large bulldozers to remove overburden and mine pay gravels, and usually employ various other equipment to perform special functions, such as loading the sluicebox or moving tailings. All of the mines use settling ponds in effort to reduce settleable solids in the mine effluent to acceptable levels. Approximately 260 acres were disturbed at the mine sites and about 55 acres were reclaimed during the 1987 mining season.

All federal mines in the Tolovana drainage practice some degree of recirculation of process water. In part this is necessary because of the small size of the streams, and the attendant low water supply. At least one operator in Livengood has operated a zero-discharge operation for three years. Because of the location of the mine on a bench, and the fact that they are operating in a large pit left by previous miners, all process water can be confined to the mine site, and the only possible seepage would have to be as ground water. This operation was able to obtain relief from the injunction on the basis of their record of zero discharge.

By the end of May 1988, two mining operations were granted relief from the injunction by the United States District Court for the District of Alaska. The first operation granted relief was that of John E. McClain operating in the Chatanika River watershed and the second operation was that of Alaska Placer Development operating in the Tolovana River watershed. These operators submitted extensive documentation to the court detailing their planned operations and and the anticipated environmental consequences associated with those activities for its review. After this review, all parties involved in the lawsuit concurred that the proposed operations would be unlikely to contribute significantly to cumulative or synergistic impacts on subsistence in the Minto Flats watershed.

3.3 Soils

There are four broad soil associations within the Minto Flats watershed (U.S. Soil Conservation Service 1979). These associations are only general descriptions of the specific soil types that may occur and have only been identified through interpretation of vegetation patterns from aerial photography. There may be considerable variation in the specific soil properties within each association. All of the soils in the area are cryogenic, or soils that have formed under cold conditions and show cold soil temperatures. Due to the seasonally cold temperatures, the entire Yukon - Tanana Uplands region is underlain by discontinuous, moderately thick to thin permafrost. Pewe (1982) describes permafrost as:

> "...naturally occurring material with a temperature colder than 32° F. for at least two years. Permafrost is defined exclusively on the basis of temperature. Most permafrost is cemented by ice, but permafrost without water, and thus without ice, is termed dry permafrost. The upper surface of permafrost is known as the permafrost table. In permafrost areas, the layer of ground that freezes each winter and thaws each summer, called the active layer. varies in thickness according to its moisture content. Generally, this thickness is from one half to one foot in wet, organic sediments and up to six to nine feet in well- drained gravels. When the mean annual air temperature drops below 32° F., ground frozen during the winter may not completely thaw in the summer, and a layer of permafrost may form. This layer may continue to thicken below the seasonally frozen ground. The thickness of the permafrost layer is controlled by the balance between the mean annual air temperature and the geothermal gradient. As the climate becomes colder or warmer, but the mean annual temperature remains below 32° F., permafrost thicknesses correspondingly increase or decrease by changes in the position of the base and top of the frozen ground. These changes depend not only on the amount of climatic fluctuation, but also on the amount of moisture in the ground and on the combination of geologic factors that in part control the geothermal gradient. Thus, if the geothermal gradient and mean air temperature are known, and if the surface temperature is stable for a long period of time, it is possible to predict the thickness of permafrost in areas remote from water bodies. Permafrost is essentially a phenomenon of polar and subpolar regions. About 20 percent of the world's land is underlain by permafrost. Perennially frozen ground is most widespread and thickest in northern regions of the northern hemisphere. Approximately 82% of Alaska is underlain by permafrost. Perennially frozen ground is 2,000 feet thick in northern Alaska and progressively thins to the south. In the northern hemisphere, perennially frozen ground is differentiated into two broad zones of lateral continuity. The continuous permafrost zone and the discontinuous permafrost zone. In the continuous zone, permafrost is present everywhere except under lakes and rivers that do not freeze to the bottom. The discontinuous zone includes numerous permafrost-free areas that progressively increase in size and number from north to south."

The four general soil associations in the Minto Flats watershed are:

3.3.1 The Histic Pergelic Cryaquepts

A major portion the lowlands of the Minto Flats drainage is composed of this soil type. Occupying the foot slopes, terraces, and broad floodplains of the Tolovana, Chatanika, and Tatalina Rivers, this poorly drained soil is derived from nonacid silty alluvium and is commonly associated with poorly drained organic soils. It is also found on the steep north-facing slopes of the hilly uplands in association with the well-drained Typic Cryochrepts. Here it is derived from material weathered from local bedrock. Elevations range from 300 feet to 3,000 feet. The permafrost is usually shallow and rich in ice.

On nearly level terrain, this soil supports sedge tussocks, mosses, and shrubs. Black spruce forests with a dense understory of shrubs, forbs, mosses, and lichens are found on the more sloped sites.

This soil presents severe restrictions for any intensive use or development. It is not suitable for either agriculture or forestry. Due to its silty texture and the presence of extensive ice-rich permafrost, it is very susceptible to erosion when the insulating vegetative mat is disturbed or removed. Without this protective mat, the underlying permafrost will thaw, causing erosion or local ground subsidence. On sideslopes, this erosion can appear as gullies, mudslides, slope failures, and other forms of mass movement. In level areas, the thawing can produce thermokarsts, which are areas of local subsidence. Thermokarsts can become quite large and may eventually form lakes or ponds.

3.3.2 The Typic Cryochrepts Soil Association

A major portion of the uplands of the Minto Flats drainage is composed of an association of this soil type and Histic Pergelic Cryaquepts. Typic Cryochrepts are well- and moderately well- drained and are commonly found on the hilltops and south-facing slopes of the hilly uplands, and narrow valleys of the Minto Flats drainage. Elevations generally range from 1,000 to 3,500 feet, and may occasionally exceed 4,500 feet. The soil developed from a variety of parent material. On the hills, it formed from material weathered from local bedrock. In the valleys, it formed from alluvial material washed from the surrounding uplands. The permafrost table is usually deep or absent.

White spruce, paper birch, and quaking aspen forest are found on the south-facing slopes of the hills and valleys. At higher elevations, soils are covered by alpine shrubs, grasses, lichens, mosses, and forbs.

The soils of the south-facing slopes are capable of producing commercial timber. Areas on low stable slopes may be suitable for cultivation of grain and vegetable crops and for harvesting timber. Soils on moderate to steep slopes are not suitable for cultivating and have limitations for construction. Ground disturbance on steep slopes can result in gullying and other forms of erosion.

3.3.3 The Pergelic Cryofibrists Soil Association

These soils are found in association with Histic Pergelic Cryaquepts on the broad floodplains of the Tolovana, Chatanika, and Tatalina Rivers. The area is characterized by meandering sloughs, small rivers and streams, and undrained depressions. Elevations range from 300 to 1,000 feet. These are organic soils which have formed through the eutrophication of ponds and sloughs. They consist of layers of fibrous moss and sedge peat. Under this soil, the permafrost table is shallow.

In broad wet depressions, mosses, sedges, shrubs, and forbs cover the ground in a thick, dense mat. Low mounds covered with black spruce may occur in or adjacent to the depressions.

Because of wetness and permafrost, this soil presents severe restrictions for any intensive use or development. It is not suitable for either agriculture or forestry. Many areas provide excellent habitat for nesting waterfowl.

3.4 Water Resources

3.4.1 Interrelationships and Overview

Water enters the watershed in three primary ways: as precipitation, intercepted atmospheric moisture, and condensation. Some of this water adheres to the leaves and branches of vegetation and is either adsorbed, drips to the vegetated floor, or evaporates.

Precipitation reaching the vegetated floor contributes first to surface storage on the vegetated litter, or it is ponded in depressions, or held in the snowpack. It then infiltrates the soil or runs off as overland flow. Water infiltrates, flows laterally, and eventually surfaces as streamflow.

Infiltrated water is detained temporarily by the soil as it percolates toward groundwater or streams, but a portion is retained, eventually to be evaporated or transpired. The amount of water retained and available for use by vegetation depends on soil density, structure, depth, and organic matter content. Evapotransportation is related to the regional climate and to the microclimate as controlled by local slope, aspect, elevation, and vegetation.

Yield is defined as water not evaporated, transpired, or retained by the soil to satisfy future evapotranspiration needs. It includes both surface runoff as the streamflow, and subsurface losses to groundwater. Streamflow is the product of input (precipitation) minus loss (evapotranspiration, contribution to groundwater aquifers, and the capacity of the soil to store water).

While it is generally apparent that water exerts a major control over vegetation, vegetation has some control over water. Natural or human-caused modification of the vegetative cover has the potential for affecting all segments of the hydrologic cycle:

1) The distribution of water and snow on the ground.

2) The amount of water intercepted or evaporated by foliage.

3) The amount of water that can be stored in the soil or transpired from the soil by vegetation.

4) The physical structure of soil, which governs the rate and pathways of water movement to stream channels.

In turn, any of these changes can have a major effect on streamflow. Streamflow characteristics potentially altered by human activities such as placer mining, as well as natural events such as wildfire or loss to disease, include annual yields and peak flows.

Stream temperature is controlled by exposure to direct solar radiation and the temperature of inflowing tributary or ground water. Stream temperature may be affected by practices which remove shade from streamside areas or alter channel morphology.

Aspects of concern regarding the chemical composition of stream water include acidity, inorganic cations and anions, and organic substances. The chemical constituents and acidity are controlled principally by mineral weathering in the parent materials and soils.

The sediment load of a stream (both suspended and bedload) is determined by such characteristics of the drainage basin as soils, vegetation, precipitation, topography, and land use. The estimated 1987 sediment loads for the Minto Flats drainage are shown in Figure 3-1. Sediments enter the stream system by a variety of erosional processes. To achieve stream stability, an equilibrium must be sustained between sediment entering the stream and sediment transported through the channel. Human activities such as mining, as well as natural events which change sediment loading can upset this balance and result in physical and biological changes in the stream system.

Water yield is the final product of the hydrologic cycle and reflects water-soil-vegetation interactions. Of concern are such runoff characteristics as the amount and temporal variations. and quality as indexed by temperature, dissolved constituents, suspended sediments, and bedload.

	1987				
Category	Annual Tonnage Rate of sediment per square mile	X	Square miles of a category in Minto Flats	=	Annual Tonnage Rate of sediment per category in Minto Flats
Forest	24	X	3,100.00	=	74,400
Abandoned Surface Mines	2,400	X	2.73	=	6,552
Active Surface Mines	48,000	X	0.41	=	19,500
Construction (mining roads)	48,000	X	0.39	=	18,727
Construction (other)*	48,000	X	51.98	=	2,495,000

*Estimated to include 46.8 square miles of housing and development and 5.1 square miles of major roads such as the Steese and Elliott Highways.

Figure 3-1. Methodology used to obtain tonnage sediment rates for various categories in Minto Flats. Square mile sediment rates taken from EPA.

3.4.2 Basin Characteristics

For the purposes of this document the "Minto Flats watershed" is defined as those lands which are drained by the Tolovana River, Chatanika River, and Goldstream Creek. These three drainages are located in Interior Alaska in what is known as the Yukon - Tanana Hills uplands.

Cold temperatures and occasional winds can create extreme wind chill conditions in the winter months. Due to such temperatures conditions, waters freeze over in the late fall and can be expected to support vehicle traffic by November 15. The river remains frozen until the spring breakup, generally around May 15.

Precipitation information for Livengood, located in the northern portion of Minto Flats, is presented below in Figure 3-2.

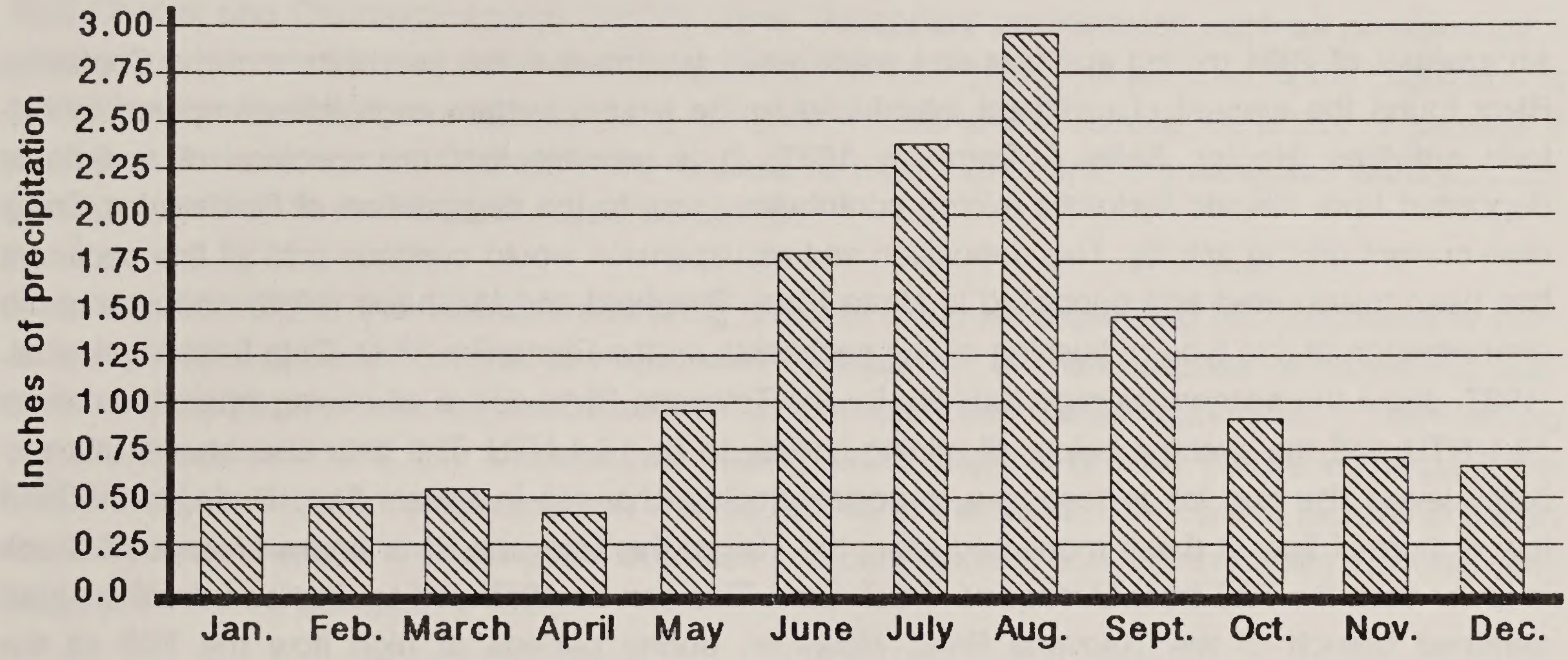


Figure 3-2. Mean precipitation at Livengood. Summary of data from 1933. 1937-48, and 1962-66. Source: Arctic Environmental Information and Data Center. University of Alaska.

Mean annual precipitation in Minto Flats equals 11.8 inches per year, with a record 17.33 inches in 1967. There were persistent high waters or extensive flooding of Minto Flats in the high precipitation years of 1955, 1962, 1964 and 1967 (Shepherd 1987). The precipitation in the upper reaches of the subject waters would be expected to be somewhat higher due to the increased elevation and the resulting orographic influence on storm fronts. This phenomenon would be most noticeable in the winter snowpack. Mean annual runoff in these drainages is probably around 0.5 cfs per square mile, although there can be great variability from year to year. The lowland areas such as Minto Flats are very susceptible to channel icing and ice jam flooding during spring breakup. During the winter months the flows drop substantially, with many of the smaller drainages freezing completely. Discharge on the Tolovana River at the Alaska Pipeline crossing (below mining activity) was monitored by the Alaska Division of Geological and Geophysical Surveys (ADGGS) during the summer of 1987 and averaged 158 cfs.

Typical streams and rivers in this region of Alaska could be expected to have good water quality. Dissolved solids average less than 200 mg/l and are generally of the calcium bicarbonate type with low iron content. Sediment loads range from 10 mg/l to 300 mg/l with small tributary streams carrying generally less than 10 mg/l (Selkregg 1974). Most of this sediment is introduced through bank and bed erosion from reworking of the valley deposits. However, the three water courses of concern in this analysis have been periodically inundated by sediment introduced from upstream placer mining operations. It is estimated that the amount of overburden and muck washed down Goldstream

Creek in 1940 was 14.3 million cubic yards. Estimates of the combined amount of muck carried by the Chatanika River and Goldstream Creek from hydraulic stripping are as high as 100 million cubic yards. Heavy sediment loads in Goldstream Creek during the intense mining of the 1930's and 1940's caused the inlet channel to Minto Lake to fill in. Goldstream Creek was then created a new channel, eventually combining with Little Goldstream Creek in Minto Flats. This channel migration also caused some smaller lakes to completely or partially fill in (ADF&G 1987a). Mining in the Livengood area in the headwaters of the Tolovana River introduced as much as four million cubic yards of muck to the stream system prior to 1981 (Shepherd and Matthews 1985).

An analysis of 1984 mining activities and waste water treatment in the headwaters of the Chatanika River found the amount of sediment introduced to the stream system negligible compared to historic activities (Hagler, Bailly & Company 1987). It is possible that resuspension of sediments deposited from historic hydraulic mining contributes more to the degradation of Goldstream Creek than current mining activity. This deposition and resuspension would continue until all fine sediment has been transported and deposited in Minto Flats. Shepherd and Matthews (1985) documents the phenomenon of this type of flushing of fine sediments on the Chatanika River. Data from Mack et al. (1987) show the season average turbidity for the Tolovana River above all mining operations to be 10.1 NTU and the average below all mining activity to be 16.4 NTU. The data also shows that turbidity levels rise and fall in response to corresponding changes in stream flow. During periods of low or normal flow at these monitored sites, the TSS of the Tolovana River below Livengood Creek is lower than the TSS from Livengood Creek itself. This can be attributed to dilution from the upper unmined branch of the Tolovana River. However, during periods of high flow the TSS of the Tolovana below Livengood Creek is higher than the TSS of Livengood Creek despite the expected decrease from dilution. It can be inferred that there is a large amount of fine material in the channel of the Tolovana River below mining operations which is resuspended and transported during periods of high flow.

Mining in the Chatanika River, although contributing large amounts of sediment and increased historic turbidity, has not had the impact in recent years as in the past (Townsend 1987). In an evaluation of available data for the Minto Flats area, Arctic Hydrologic Consultants (1988) found impact by mining to be greatest on Goldstream Creek, and least on the Tolovana River. Impact to the Chatanika River was found to be substantially less than to Goldstream Creek.

Placer mining in the Chatanika River, Tolovana River and Goldstream Creek has resulted in a number of impacts on the water quality and, in the case of at least Goldstream Creek, changes in channel morphology. These impacts include elevated turbidity levels and increased sedimentation of stream channels and Minto Flats. Although impacts to the stream systems are not well documented, potential results include perched stream channels, changes in the piezometric surface, filling and eutrophication of lakes in the depositional areas, alteration of stream courses, and reduced primary productivity.

Even though the rates of natural sedimentation for these drainages is not known, the dredging and hydraulic mining operations of the past undoubtedly accelerated the natural process. The sediments in lower Goldstream Creek and input from current operations will continue to deposit sediments in Minto Flats.

Hazardous Materials

Most mining operations in Alaska use only a limited variety of materials which are currently categorized as hazardous. In the Minto Flats drainage these are currently limited to fuels and solvents. The use of explosives or the chemical processing of gold-bearing ores, the other likely sources of hazardous materials in placer operations, are not anticipated within the period encompassed by this analysis. Regulations at 40 CFR 112 require that operators of facilities with fuels stored in excess of 660 gallons per single container or 1,320 gallons in aggregate prepare and implement Oil Spill Control and Countermeasures (SPCC) plans. Secondary containment, such as provided by a continuous berm or dike, is required in conjunction with the plan. The purpose of the regulation is to reduce the likelihood of a spill reaching navigable waters and to reduce the extent of damage if such a spill should occur. Operators are required to report spills entering navigable waters or adjoining shorelines to the National Response Center.

State regulations (18 AAC 75) require differing levels of response depending on the amount of hazardous material spilled. However, any spill must be reported. Ultimate disposal of hazardous substances must be approved by the Department of Environmental Conservation (DEC); however, no permit is required. While little attention has been given to disposal of solid wastes in the past, the DEC intends to require compliance with the regulations in the future. The current recommendation for such waste disposal is burning combustibles and back-hauling non- combustibles. Landfills may be permitted on a site-specific basis.

To summarize, past and present effects on the three individual drainages of Minto Flats are as follows:

> **Tolovana River:** has been a problem historically due to hydraulic stripping, but present data indicate that for the most part mining activities on this river does not significantly impact the water quality.
>
> **Chatanika River:** has been a problem, but enforcement emphasis by the State of Alaska and BLM, and cooperation of the mining community has improved the water quality in this drainage to fairly good conditions.
>
> **Goldstream Creek:** the sediment problems in Goldstream Creek appear to be continuing, with DEC and EPA not strictly enforcing water quality standards, especially on private lands in the watershed, and the preponderance of non-mining construction in the watershed. It is not clear however, what proportion of sediments in the water are attributable to mining and other development such as roads and housing.

Although there are insufficient data to apportion sources of sediment input, erosion estimates presented in Figure 3-1 indicate that the majority of sediments produced from surface disturbance within the basin are derived from road corridors and other types of non-mining activities. In the analysis of data gathered during the 1987 operating season (AHC 1988) indicate that turbidity on mining-impacted streams in the basin continued to drop compared to turbidity produced in previous years. Median values for turbidity on the Tolovana River were low for mining affected streams in the basin. High values which did occur were probably a result of non-point source input since response was well correlated to level of flow as were turbidity values for Faith Creek (Figure 3-3). Turbidity values on heavily mined Goldstream Creek (55% of the stream mined) were high for the basin, and exceeded criteria on a regular basis. Discharges were not well correlated to flow (Figure 3-4). Data for suspended solids are sparse. There is considerable question about the effect of mining on sediment levels in comparison to background conditions, particularly during high runoff. The Tolovana River at the TAPS crossing carries a relatively high load of sediments (Figure 3-5). The most recent data presented (Mack et al. 1988) indicate that sediment yields for the unmined upper reach of the Tolovana River are higher than for streams within the basin which are affected by placer operations. This is not consistent with similar analyses based on earlier data. In part, such differences may be due to changes in mining practices and increased enforcement of discharge standards; no explanation was given. Suspended solid levels at the mouth of Goldstream Creek were comparatively low. Loss of surface flow to groundwater recharge in this basin indicates the depositional environment in which sediments are deposited in the stream channel in the low-lying Minto Flats area. No current information on amounts of sediments deposited or transported is available. Information presented for Faith Creek indicates a substantial decrease in sediment load over the previous mining season. Deposition of sediments discharged into the Chatanika River apparently occurs largely within 25 miles of the Faith Creek Confluence (Figure 3-6). No information is available on stream channel condition for the lower Chatanika River.

Although there have been water quality monitoring efforts on the streams within the Minto Flats which are affected by mining operations, there is no information available for the Tatalina Basin or the lower reaches of Goldstream Creek, the Chatanika River, or the Tolovana River. The Arctic Hydrologic Consultants study (1988) concludes that data available are generally insufficient to verify impacts of mining to chemical water quality. Of those parameters evaluated, temperature was verifiably higher in streams affected by mining. For trace metals sampled arsenic concentrations below mining had a median value above the detection limit, and one of those values may have exceeded the State water quality standards depending on valence and water hardness. Although hard-

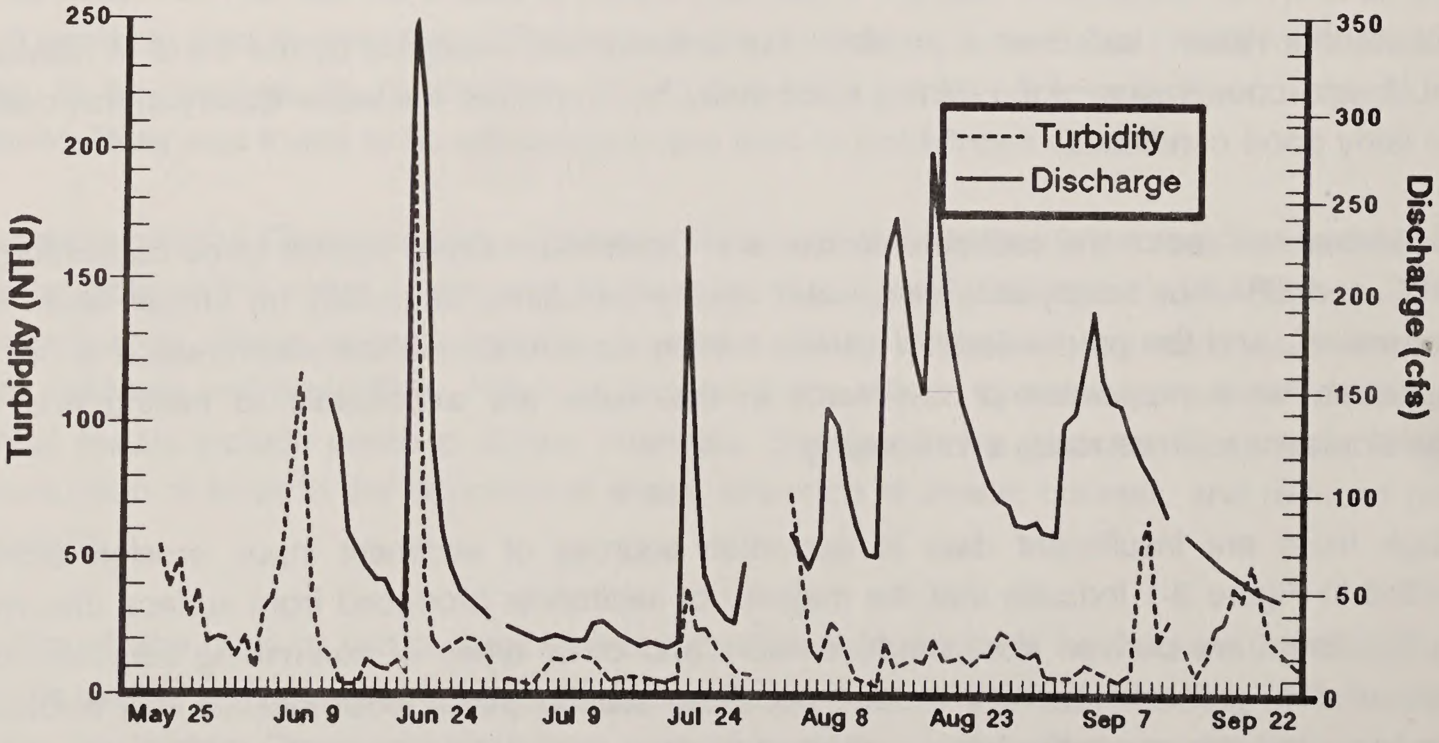


Figure 3-3. Turbidity and discharge on Faith Creek at the Steese Highway during Summer 1987. (Mack. et al. 1988)

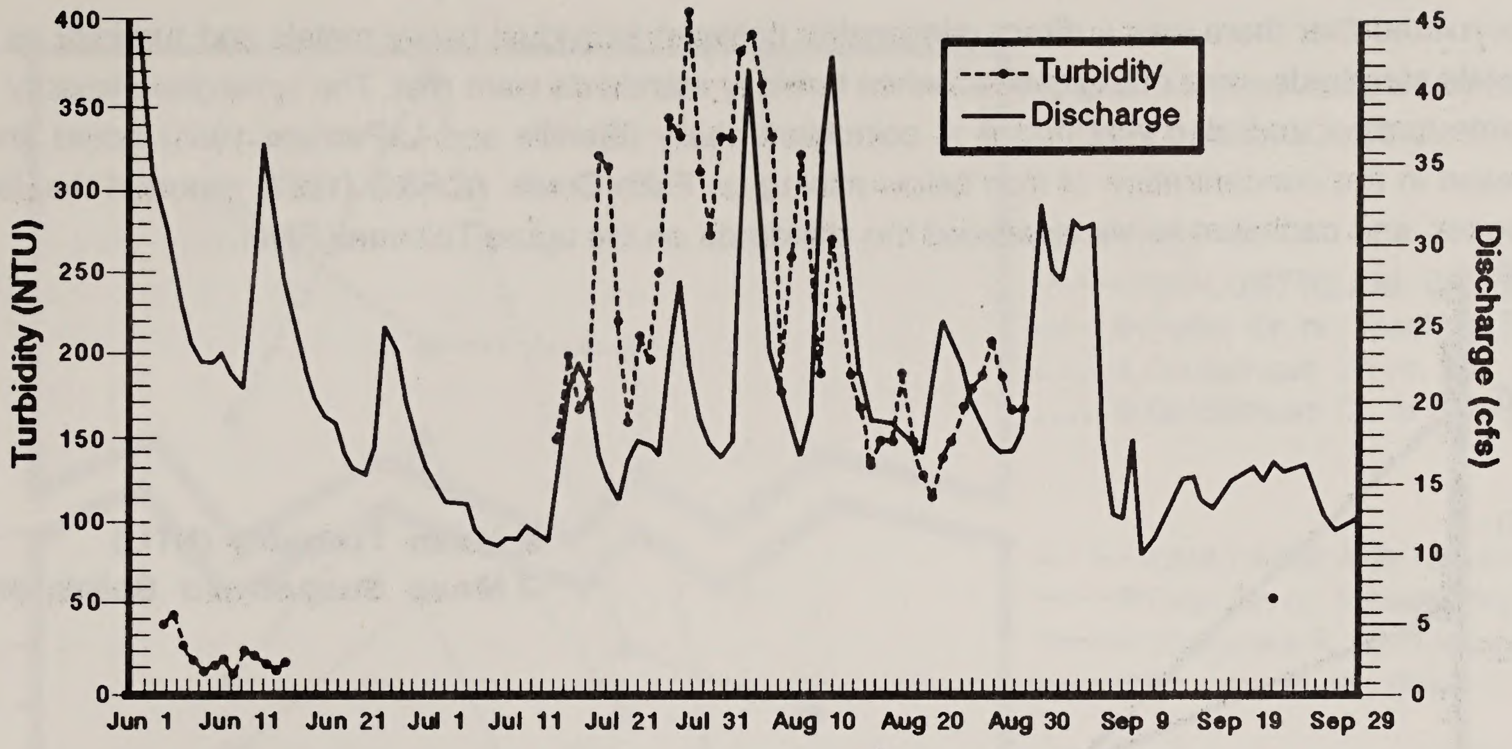


Figure 3-4. Turbidity and discharge on Goldstream Creek at Ballaine Road during Summer 1987. (Mack. et al. 1988)

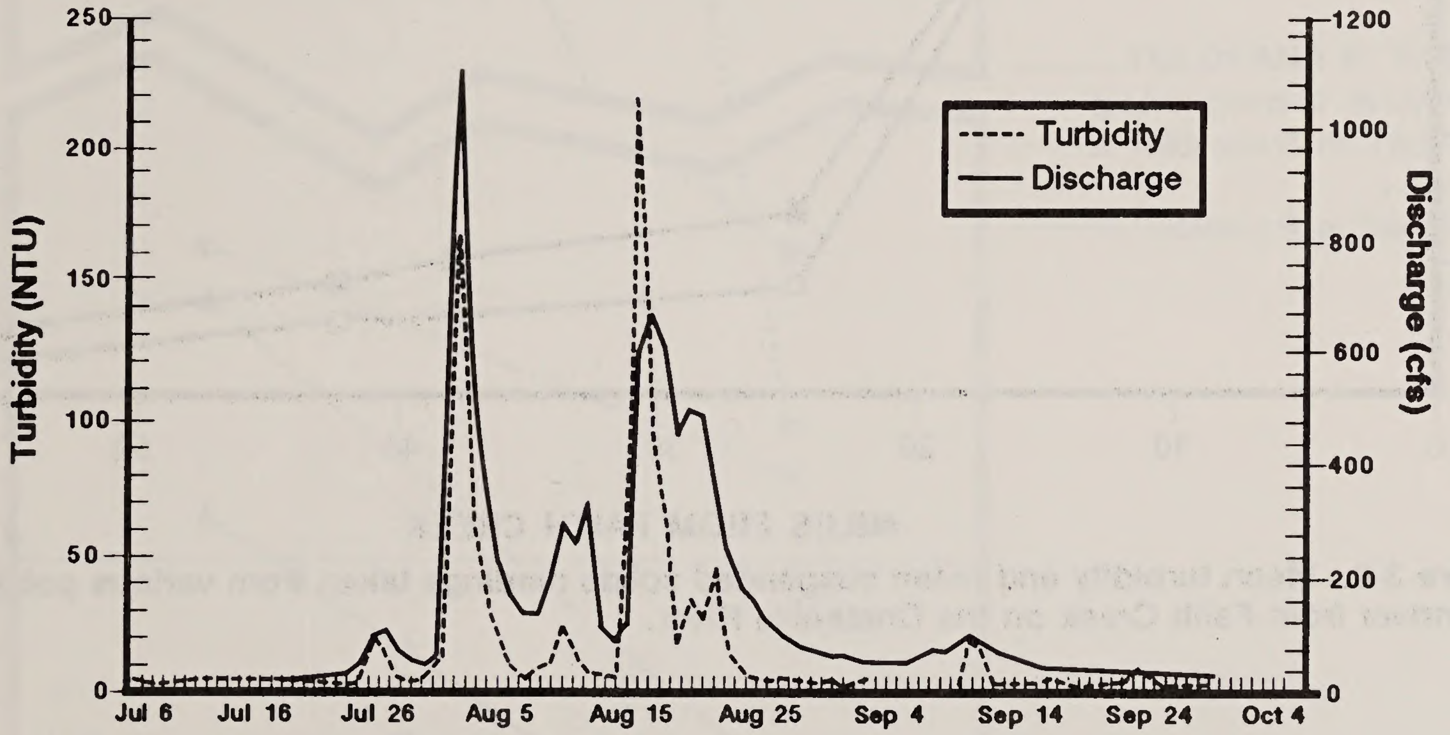


Figure 3-5. Turbidity and discharge on the Tolovana river at the TAPS crossing during Summer 1987. (Mack. et al. 1988)

ness and pH values were slightly higher below mining. this was not found to be statistically significant. Data compiled by AHC indicate that turbidity levels have decreased in the Goldstream Creek, Tolovana River, and Chatanika River basins during the years 1983-1987 (see Figure 3-7). There does not appear to be a significant difference in nutrient levels on streams affected by mining. In a study of a limited set of total trace metals for Goldstream Creek, ADEC (1981) reported that iron and manganese exceeded the potable water standards. In a paired stream study of mined Faith and unmined McManus Creeks (LaPerriere et al. 1985) it was found that mining resulted in elevated levels of copper. zinc, lead, and arsenic, with lead values elevated on a regular basis. Copper and zinc occasionally exceeded the water quality standards on McManus Creek as well. The authors speculated that there was a direct relationship between individual heavy metals and turbidity as the metals standards were not exceeded when turbidity standards were met. The synergistic toxicity between copper and zinc was noted. A coincident study (Bjerklie and LaPerriere 1985) noted an increase in the concentration of iron below mining on Faith Creek. ADF&G (1987) reported that lead, copper, and cadmium levels exceeded the standards on the upper Tolovana River.

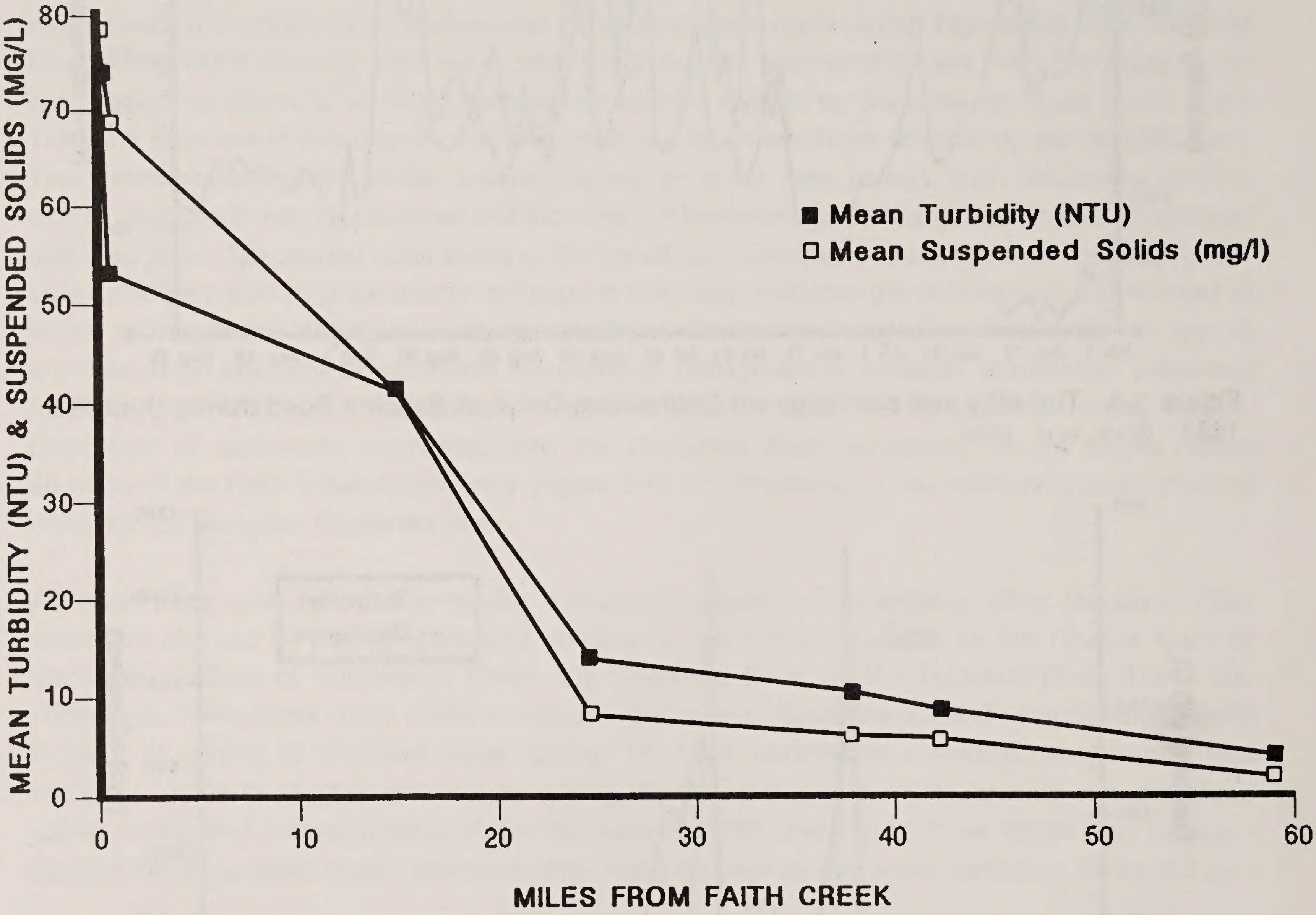


Figure 3-6. Mean turbidity and mean suspended solids readings taken from various points downriver from Faith Creek on the Chatanika River.

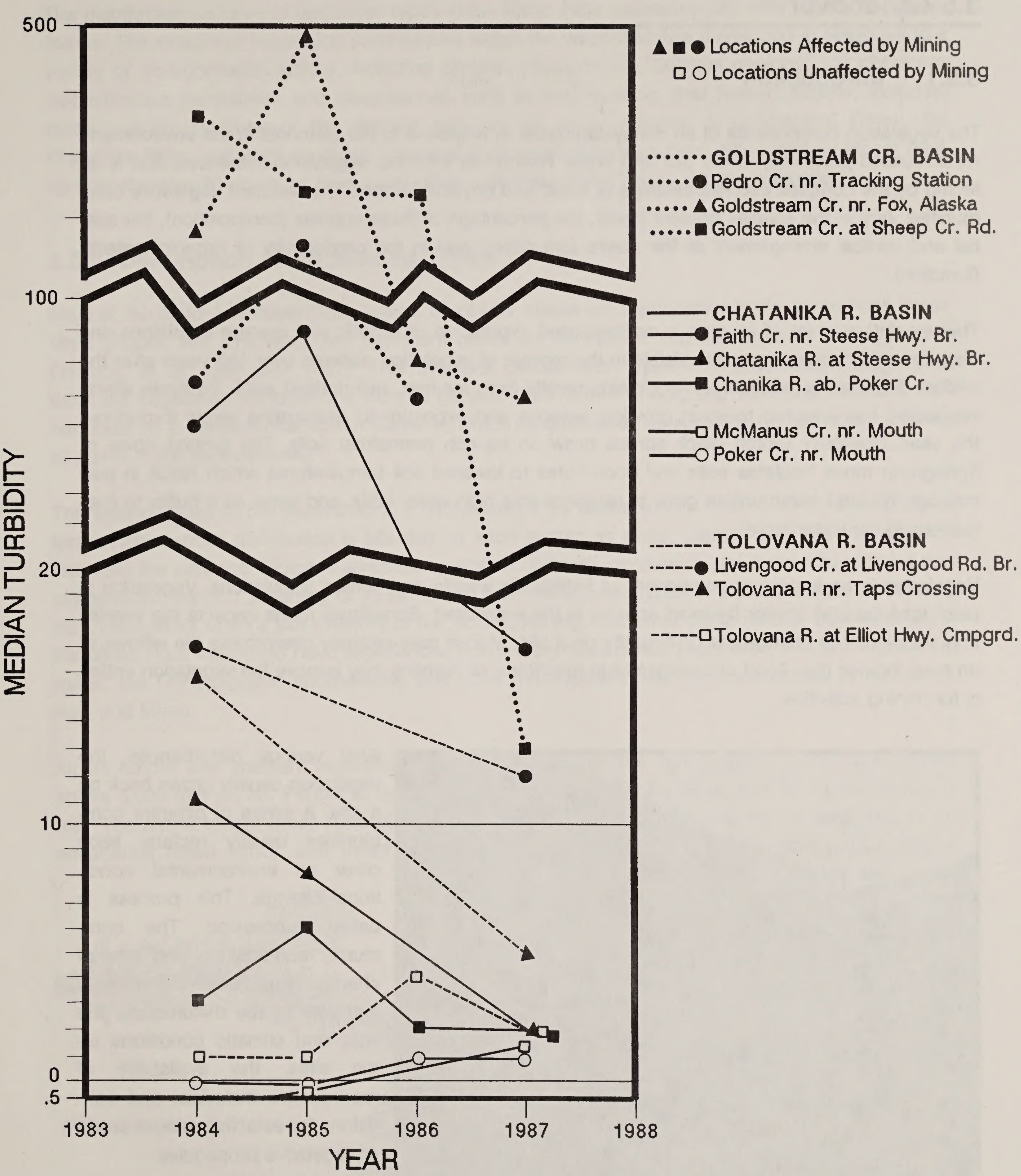


Figure 3-7. Median Turbidity within Goldstream Creek, upper Tolovana River, and Chatanika River Basins. From Arctic Hydrologic Consultants 1988.

3.5 Landcover

3.5.1 Introduction

The vegetation components of an ecosystem grow in response to the elements in the environment. As discussed previously in the Soil and Water Resources sections, vegetation influences, and is affected by the complex interrelationships of biotic and physical factors. The resultant vegetative communities vary in the species present (flora), the percentage of these species (composition), the spatial and vertical arrangement of the plants (structure), and in the productivity of organic material (function).

The vegetative cover of an area is an integrated expression of historic and present conditions and disturbances. Burned areas are visible in the mosaic of vegetation patterns over 100 years after the wildfire. Riparian vegetation on floodplains results from ice-free, well-drained soils. Prostrate alpine vegetation has adapted to short growing seasons and exposure to desiccating winds throughout the year. Shallowly rooted black spruce grow on ice-rich permafrost soils. The ground cover of *Sphagnum* moss insulates soils and contributes to lowered soil temperatures which result in permafrost. Wetland communities grow in response to a high water table, and serve as a buffer to fluctuations in the water table.

Vegetation is an important component of habitat for wildlife and human populations. Vegetation is used for food and shelter by most species in the watershed. Sometimes fauna impacts the vegetation sufficiently to change the community on a site. Moose may severely overbrowse the willows of an area, beaver may flood out sedge/shrub meadows, or humans may remove the vegetation entirely for mining activities.

Revegetation on a 40-year-old tailing pile consisting of dry gravel with a small amount of fine materials.

After various disturbances, the vegetation usually grows back on a site. A series of different communities usually replace each other as environmental conditions change. This process is called succession. The community composition and rate of change result from the severity and size of the disturbance, the soils and climatic conditions on the sites, the availability of reproductive materials, and conditions for establishment of seeds or vegetative propagules.

The distribution patterns of landcover types in the Minto Flats watershed are fairly typical of Interior Alaska. The mosaic of vegetation communities within the watershed has developed in response to a variety of environmental factors, including climate, physiography, surficial geology, soil character, discontinuous permafrost, and disturbances such as fire, flooding, and human actions, including placer mining. Portions of the riparian zone in the upper reaches of Goldstream Creek, the Chatanika River, and portions of the Tolovana River watershed have been influenced by placer mining over the past 90 years, as have most other drainages in the Yukon-Tanana watershed.

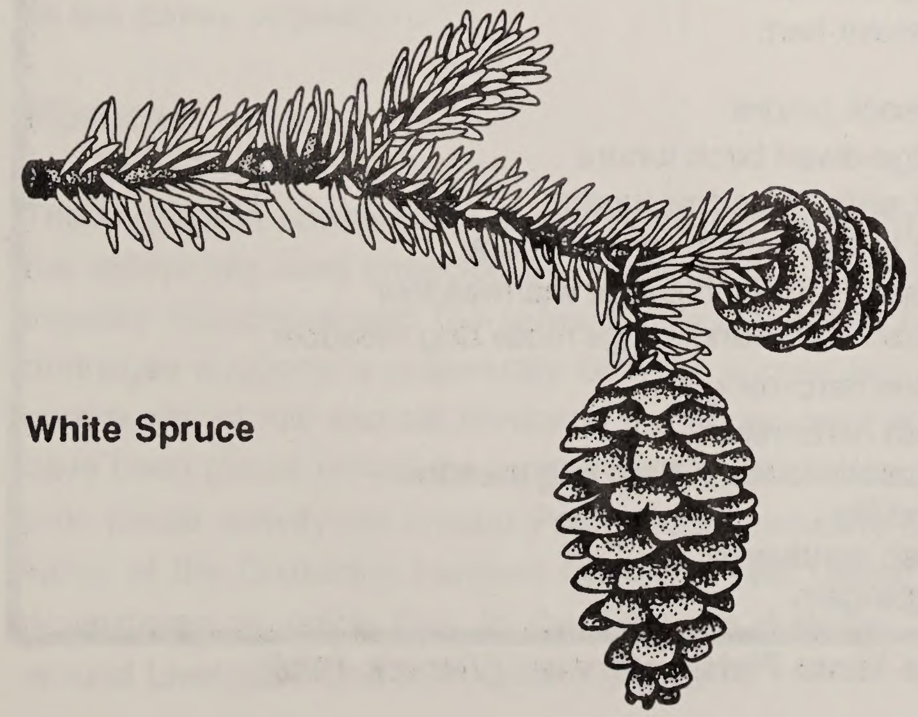
3.5.2 Description of Vegetation Types

Most of the major landcover types typical of Interior Alaska are represented in the Minto Flats watershed (Figure 3-8). The landcover types are based on the Alaska Vegetation Classification System (Viereck, et al. 1986 and 1987). This five-level classification system is specifically designed to describe vegetation associations from a general level (Level I including forest, scrub, and herbaceous) to a detailed description (Level V, which incorporates the scientific names of the species of plants in the associations).

The upland areas of the watershed are characterized by alpine tundra types and by a diversity of forest types whose distribution is affected by such factors as slope, aspect, soils, permafrost, and repeated fire patterns. Riparian areas along stream channels on current and former floodplains and old terraces support a variety of forest, shrub,and herbaceous types in various stages of succession, dependent upon a site's history of fire, floods, mining, and other disturbances. Several areas in the Minto Flats watershed have experienced non-mining disturbance associated with construction of roads, the TAPS pipeline, subdivisions, and other development near the communities of Fairbanks, Fox, and Minto.

Alpine tundra and sparsely vegetated communities grow on the various domes and high country above 3,000 feet on Mt. Prindle at the headwaters of the Chatanika River, and on Sawtooth Mountain. The alpine tundra areas have plant associations of *Dryas* dwarf scrub, plants belonging to the ericaceous heath family; and dwarf scrub of bearberry, blueberry, and mossberry. *Cassiope* is widespread on moist alpine sites, as is willow tundra. The lichen components are variable and include fruticose and crustose growth forms. A shrub tundra community of ericaceous shrubs and dwarf birch with scattered alder grows at slightly lower elevations (2,400-3,000 feet) on Murphy and Livengood Domes and other rounded domes in the drainages.

Lower rolling slopes support communities of dwarf and low shrubs, and sedge/shrub tundra. Mixed in with the forest components are tall and low scrub



White Spruce

LEVEL I CLASS	COMMUNITY	LEVEL IV CLASS	PLANT CANOPY DESIGNATION
Forest	Riparian	White Spruce	closed, open, woodland
	Riparian	Black Spruce	closed, open, woodland
		Black spruce-white spruce	closed, open, woodland
		Black spruce-tamarack	open, woodland
	Riparian	Balsam poplar	closed, open
	Successional	Birch	closed, open
	Successional	Aspen	closed, open
	Successional	Birch-aspen	closed, open
	Riparian	Spruce-birch	closed, open
		Aspen-spruce	closed, open
	Riparian, Successional	Poplar-spruce	closed, open
Scrub	Riparian	Tall willow	closed, open
		Tall alder	closed, open
	Riparian	Tall alder-willow	closed, open
	Riparian	Low willow	closed, open, sparse
		Low willow-alder	open
	Riparian	Mixed shrub-sedge tussocks	open
		Mesic shrub birch-ericaceous shrub	open
	Riparian	Ericaceous shrub bog	open
	Riparian	Shrub birch-willow	open
	Riparian	Willow-gramnoid bog	open
Dwarf shrub		Dryas tundra	
		Dryas sedge tundra	
		Vaccinium tundra	
		Cassiope tundra	
		Willow tundra	
Herbaceous		Midgrass shrub	
		MIdgrass herb	
	Riparian, Successional	Bluejoint-herb	
	Riparian	Tussock tundra	
	Riparian	Sedge-dwarf birch tundra	
	Riparian	Wet sedge meadow tundra	
	Riparian	Wet sedge-herb meadow tundra	
		Subarctic lowland sedge wet meadow	
		Subarctic lowland sedge moss bog meadow	
		Alpine herb-sedge	
		Fresh herb marsh	
		Subarctic lowland herb bog meadow	
		Pond lily	
		Fresh pondweed	
		Cryptogam	

Figure 3-8. Landcover types in the Minto Flats watershed (Viereck 1986).

communities of alder, willow, and ericaceous shrubs such as Labrador tea and blueberry, and dwarf birch. On the better-drained slopes the ground layer may be composed of herbaceous plants, mosses, and lichens such as the *Cladina spp* (reindeer moss), and some graminoids. The poorly drained and wetter slopes are characterized by more alder and some willow with a ground layer of *Sphagnum*, sedge tussocks, other mosses, and foliose lichens like *Peltigeria*. This mosaic of shrub and moss/sedge types is prevalent in the low wetlands.

Birch, aspen, and balsam poplar are the three major deciduous tree species in the study area. Aspen generally grows on the warmest and driest south-facing slopes with no permafrost (Rieger, et al. 1963). Birch stands grow on south-facing slopes, near the tops of hills on north-facing slopes, and on moderately drained sites in the valleys with discontinuous permafrost. Balsam poplar grows primarily on the floodplains of major drainages, with scattered stands on south-facing slopes. The distributions of all three species overlap to some extent (Spencer 1981). Large stands of aspen and/or birch forests are on the hills in all drainages of the Minto Flats watershed. Stringers of birch and willow grow in the wetlands of Minto Flats.

Some valley slopes in the watershed were logged for firewood, which was used for thawing ground or dredges in the early 1900's, or have been burned by wildfires. During the late 1940's through the 1960's, fields were cleared to prove up on homesteads in the Goldstream Valley. Many of these areas are currently vegetated with dense single-aged deciduous forests.

Black spruce and low shrub/moss types grow on most of the gentle slopes in the drainage. Open black spruce and black spruce/birch stands are common on poorly-drained, cold sites on north- and east-facing slopes. These slopes are usually underlain by permafrost. Large stands are in the broad gentle valleys of lower Goldstream Creek, Chatanika, and Tatalina Rivers, and the West Fork of the Tolovana. Some of the lowland areas have been burned within the past 100 years, and the black spruce is in a mosaic with various shrub and deciduous regrowth types.

Open white spruce and white spruce/black spruce stands are commonly found on the drier, well-drained south and west-facing slopes. Birch, birch/aspen, and spruce/birch stands are vegetation associations which also grow on these slopes, but are often successional to stands of white spruce as the climax vegetation.

Riparian

The vegetation communities in the riparian zone along the stream floodplain and lowland areas of the valleys are most impacted by placer mining, and will have the greatest variation in the resultant impacts associated with the various alternatives (Section 4.5). The riparian zone along the major drainages supports a community of white spruce and balsam poplar in the lower reaches, and a community of low and tall shrubs in the upper parts of the drainage. The bottoms of creeks which have been placer mined are mostly barren, with some shrub regrowth. Major concentrations of historic placer activity are around Pedro Dome including Cleary, Eldorado and Dome Creeks; and the valley of the Chatanika between Chatanika and Olnes, the Goldstream headwaters, and tributaries downstream to below Fox. In the Tolovana drainage, areas of old placer mining disturbance are around Livengood and surrounding creeks.

The closed needle/leaf forest (canopy cover greater than 60%) types include white spruce along the rivers and drainages located on well-drained, permafrost-free soils; black spruce generally occurring on poorly-drained organic soils which are often underlain by permafrost; and black spruce/white spruce forests on the river terraces.

The closed broadleaf forest (canopy greater than 60%) is represented by the balsam poplar which occurs most frequently on river floodplains. There is a closed, mixed forest type of poplar/spruce which is an intermediate successional stage leading to the white spruce climax on floodplain sites.

Tall scrub includes willow thickets which are especially characteristic of floodplains and river banks, and shrub swamps of alder and willow which occur on floodplains and in drainageways.

Low scrub stands occur in wet stream bottoms, poorly-drained lowlands underlain by permafrost, and floodplains. These communities include dwarf birch/ericaceous shrub bog, mixed shrub/sedge tussock bog, ericaceous shrub bog, shrub birch/willow, and willow/graminoid bog.

Recently disturbed gravel bars and tailings support sparse shrub communities, usually willow, alder, and balsam poplar seedlings.

Riparian Herbaceous

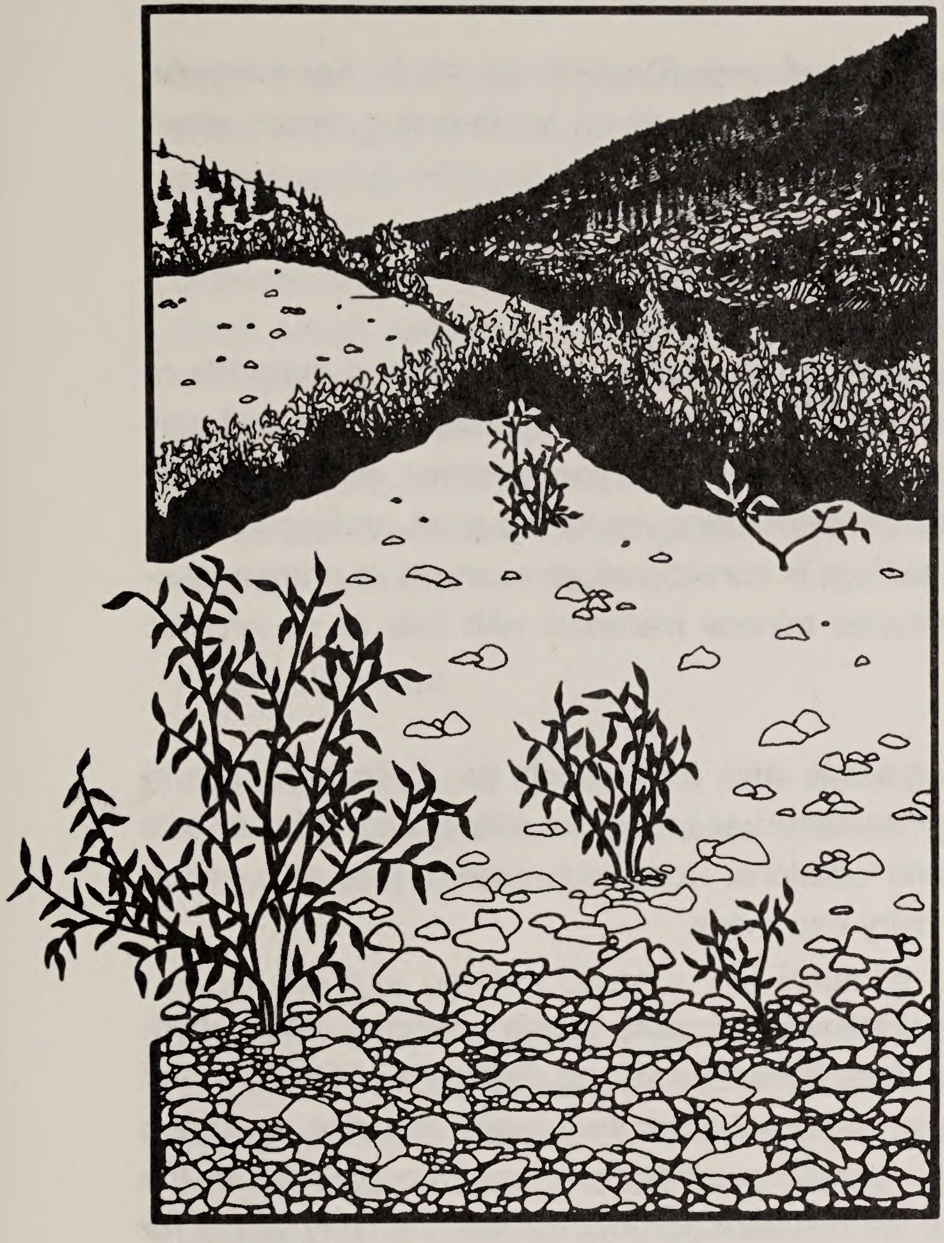
Wet sedge/herb meadows and lowland sedge wet meadows are common on very wet, poorly-drained sites with standing water such as oxbow lakes, floodplains, and margins of ponds, lakes and sloughs.

Another herbaceous type is the pioneering community of grasses and forbs on recently disturbed gravel bars or tailings.

Wetlands

Wetlands, an important component of the ecosystem, act as a buffer for water quality, and are subject to long-term effects after disturbances.

> "Wetlands play a major role in maintaining hydrologic systems and the quality and quantity of surface and ground waters. Some wetlands can absorb large quantities of water and act as natural flood control systems for rivers by gradually releasing floodwaters and reducing the magnitude of high flows. Wetlands may slow the rate of runoff during periods of normal rainfall and help recharge aquifers. In some places, sediments and pollutants may be filtered out of water draining through wetlands, and water quality may thus be improved. Wetlands are extremely important to resident and migratory birds for resting, feeding, and nesting and can be important foraging grounds for large mammals such as caribou, moose, and bear." (DOI et al. 1987f).



Revegetation

Wetlands have been defined by the COE in 33 CFR 323 as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." The COE definition allows that any vegetated area which is underlain by ice-rich permafrost typically meets the wetland definition. Therefore, many areas in the Minto Flats watershed below the alpine zone are wetland in character and subject to Section 404 of the Clean Water Act. The COE definition of wetlands differs from other wetland definitions used in Alaska. These definitions are based on water saturation of the upper strata of the substrate and standing water at the surface, and such areas usually do not include all black spruce and many scrub communities as wetlands.

The Minto Flats watershed has extensive areas of wetlands. Minto Flats itself, where five major streams join and meander before flowing into the Tanana River, is nearly 500,000 acres. The mosaic of deciduous and conifer stringers, old ponds and sloughs, floating mats, and wet shrub and sedge types extends from the Tanana River well upstream into the Tolovana and Tatalina Rivers. This is a very dynamic and diverse region, growing in response to periodic fire and flooding (Shepherd 1987).

3.5.3 Successional Patterns

The major causes of disturbance to vegetation in the Minto Flats watershed are wildfires, semi-urban development, and placer mining. After a site has been disturbed, a series of vegetation communities sequentially develops, one gradually replacing its predecessor in a systematic, successive manner. The process of succession is "the more or less orderly pattern of events and processes in nature whereby plant and animal species replace each other as a result of a changing environment" (Komarek 1971). The rate of succession results from the type, frequency, duration, and intensity of disturbance, and the basic environmental factors of a site. One simplified example of succession on a site would be vegetation types of grasses and forbs which are replaced by deciduous shrubs, which are replaced in turn by a climax community of coniferous trees. A disclimax community is maintained in an area subject to continuous repeated disturbance (Daubenmire 1968). For example, repeated fires often cause aspen and birch stands to be maintained on south-facing slopes when white spruce would be the "normal" climax stage.

Succession in Mined Areas

Succession in placer mine tails depends very heavily on the percentage of fine-grained materials or "fines" in the substrate (Holmes 1981, Rutherford and Meyer 1981). Fines (particles of silt and clay size) directly control the water, oxygen, and nutrients available to plant root systems, and the quality of the initial seed or rooting bed. Other important considerations are micro-relief and sources of seed or vegetative propagules. Vegetation of mine tailings is considered an example of primary succession because the tailings are usually undifferentiated mineral materials with little or no organic content or seed bed.

Typically, mine tailings are initially invaded by grasses and forbs such as *Calmagrostis* and fireweed, with lupine and other legumes following. Scattered seedlings of willow and alder invade next, intermixed with birch or balsam poplar in some locations. Rose or bearberry may also occur, and initial bryophytes are usually *Sterocaulon* and hairy cap moss.

As the cover of shrubs expands, the ground cover increases and more species become established. Mosses such as *Hylocomium* and *Drepanocladus*, and lichens including *Peltigeria*, *Cladina* , and *Cladonias* comprise the ground cover. At this stage, ericaceous shrubs usually colonize, including blueberry, cranberry, Labrador tea, and mossberries. Spruce seedlings also begin to grow under the shrub cover during this period. The composition of the resultant community may be fairly stable for tens of years.

In cooler and wetter areas, the organic layer accumulates. *Sphagnum* mosses flourish, and permafrost redevelops. Eventually, a black spruce low shrub *Sphagnum* moss type covers the site.

In warmer, well-drained areas, a mature, single-aged birch and/or aspen stand usually develops, with alder, willow, and white spruce saplings in the understory. If left undisturbed for a long enough period, a mature white spruce forest with scattered birch, aspen, or balsam poplar develops on the site. Riparian communities often develop old stands of 200-300 year old white spruce and balsam poplar. Above the limits of tree growth, riparian zones usually consist of tall willow and alder.

The rate of succession seems to be heavily influenced by the proportions of particles of silt and clay size in the surface layer of the tailings. Rutherford and Meyer (1981), reporting on 30-40 year old communities on dredged tailings in the Tuluksak River, documented that the growth of sparsely vegetated shrubs through dense tall shrub stands depended on soil particle size. With an increase in fines from 10% to greater than 50% there was a corresponding increase in the amount of cover, vegetation height, and species diversity. Holmes (1981), working on 50-year- old dredge tailings on Goldstream Creek at Fox, reports similar findings, with slightly longer time frames. This would be in keeping with the more northerly site. Halloran (1986), working on both recent and old tailings in the

Birch Creek drainage, Circle mining district, found that vegetation development was enhanced in areas with greater fines content. This work included data on an undisturbed site with fines content of greater than 50%, while tailing samples ranged from less than 10% to approximately 50% fines.

Observations by BLM (Spencer 1987) during the summer of 1987 support these interpretations. Small willow seedlings from five to seven years old located on tailings with moderate fines content on Faith and Portage Creeks were seen, along with tall willows aged 17 years on tailings over 30 years old at the tailings/water interface on Deadwood Creek in the Birch Creek watershed. Also noted were a tall alder/willow community on old, well-drained tailings aged approximately 40 years on Switch Creek, and dense grasses and willow shoots covering areas that had been stripped the previous year, but not sluiced.

Fire Succession

Past fire history and fire patterns have also influenced the distribution of landcover within the watershed. Fire changes the relationships between the plant and animal communities, as well as between the plants and the climate.

Often fire has positive benefits. For instance, ash from fires is high in calcium, potassium, phosphorous, and other minor elements that have been released from the organic matter in a usable, soluble form. Releasing these nutrients from the biomass is beneficial in the Alaska environment because other processes of nutrient recycling such as weathering, decay, and oxidation are exceedingly slow in the arctic and subarctic biomes. The variations caused by fire burning patterns and the adaptations of different plant species to fire also creates a complex mosaic of plant communities and ecotones in various stages of succession. These plant communities provide habitats for a large variety of animal species. Fire creates more variations in both plant and animal communities than probably any other natural force. For example, in much of the forested areas, the variations of fire intensity and frequency determine whether the affected region will be occupied by moose or caribou. Fire-scarred landcover has a visual impact on the esthetic qualities of an area for recreation utilization for many years after a burn (Komarek 1971).

Often fire or fire suppression activities affect the thick vegetative mats that have a principal insulating effect on the soil thermal regime. When this mat is altered, the frozen subsoil, often rich in silt, is released when the permafrost melts. Surface slumping and sedimentation of streams are common results of this thermal disruption and can affect even flat terrain. The overall moisture relation and thermal effects from fire are more pronounced on the south-facing slopes where the moisture balance is more critical (Lotspeich and Mueller 1971).

Lotspeich and Mueller (1971) speculate that the vast majority of Interior Alaska has burned within the past 200-250 years, though this period could possibly be too long when compared to the normal species rotation ages. They estimate rotation ages of white spruce at 100-150 years, birch at 80-100 years, aspen at 60-80 years, and black spruce at 60-80 years.

Fire has less impact on white spruce stands which are found on valley floors and terraces of the riparian zone where the burning may be less severe. White spruce also lack ladder fuels, which reduces their susceptibility to crown fires. Black spruce, which frequently burns, is well adapted to fire because of serotinous cones which can release a viable seed crop shortly after a fire. However, repeated fires can convert spruce areas to birch and aspen stands which are then maintained as a disclimax. Deciduous broadleaf trees, due to the nature of their branching, are not so affected by crown fires. Aspen usually regenerates by vegetative reproduction from root suckers if the fire does not burn down to the mineral soil (Barney 1969).

3.5.4 Threatened & Endangered Plants

Within the Minto Flats drainage there are no formal "listed" or "candidate" Threatened or endangered plant species. There are no "Endemic" plant species recognized within this drainage area. The possibility of endemic species being located within the vast region of the Minto Flats drainage is a distinct possibility because some localities are so remote that collections and other evidence are sparse. Taxonomic studies are being inventoried, but at this time are incomplete.

3.6 Wildlife

3.6.1 Species and Habitats Present

The Minto Flats area includes the wetlands and source headwaters of the Tolovana, Tatalina and Chatanika Rivers, and Goldstream Creek. The Flats provide very productive wildlife habitat for a variety of large and small game species, waterfowl, and furbearers. In the upper watershed areas there are forested and upland riparian wildlife habitats. General information regarding species descriptions and distribution patterns can be found in "Alaska's Wildlife and Habitat" (ADF&G 1978c) and "Alaska Wildlife Management Plans - Interior Alaska" (ADF&G 1976). The Minto Flats area has a long history of human use for hunting, fishing, and trapping. In recent years these wetlands have consistently been one of the three most popular waterfowl harvest areas in the state (B. Campbell, pers. comm.). The area attracts many hunters and recreationists from the Fairbanks area as well as from local communities such as Minto.

Moose are distributed throughout the Minto Flats watershed (Wildlife Moose Map) and their numbers increased during the late 1940's, 1950's, and early 1960's, reaching a maximum during the mid-1960's. Since then, moose numbers have declined in part because of severe winters. In addition, predation has been a major contributing factor to reduced populations since 1971 (ADF&G 1986a). At present, moose density is low throughout Game Management Subunit (GMS) 20B which includes the Minto Flats area. Moose density appears to be increasing in areas where wolf control has been effective (Crain and Haggstrom 1985). Shepherd (1987) notes that moose densities over the Minto Flats lowlands are currently about one moose per square mile. During the regulatory period of 1979-1985, the number of hunters increased to 2,258, while harvest increased to 332 moose per year (ADF&G 1986a). The numerous factors that can influence the seasonal and long-term distribution of moose include snow depth, elevation, range condition, fire, predator den-

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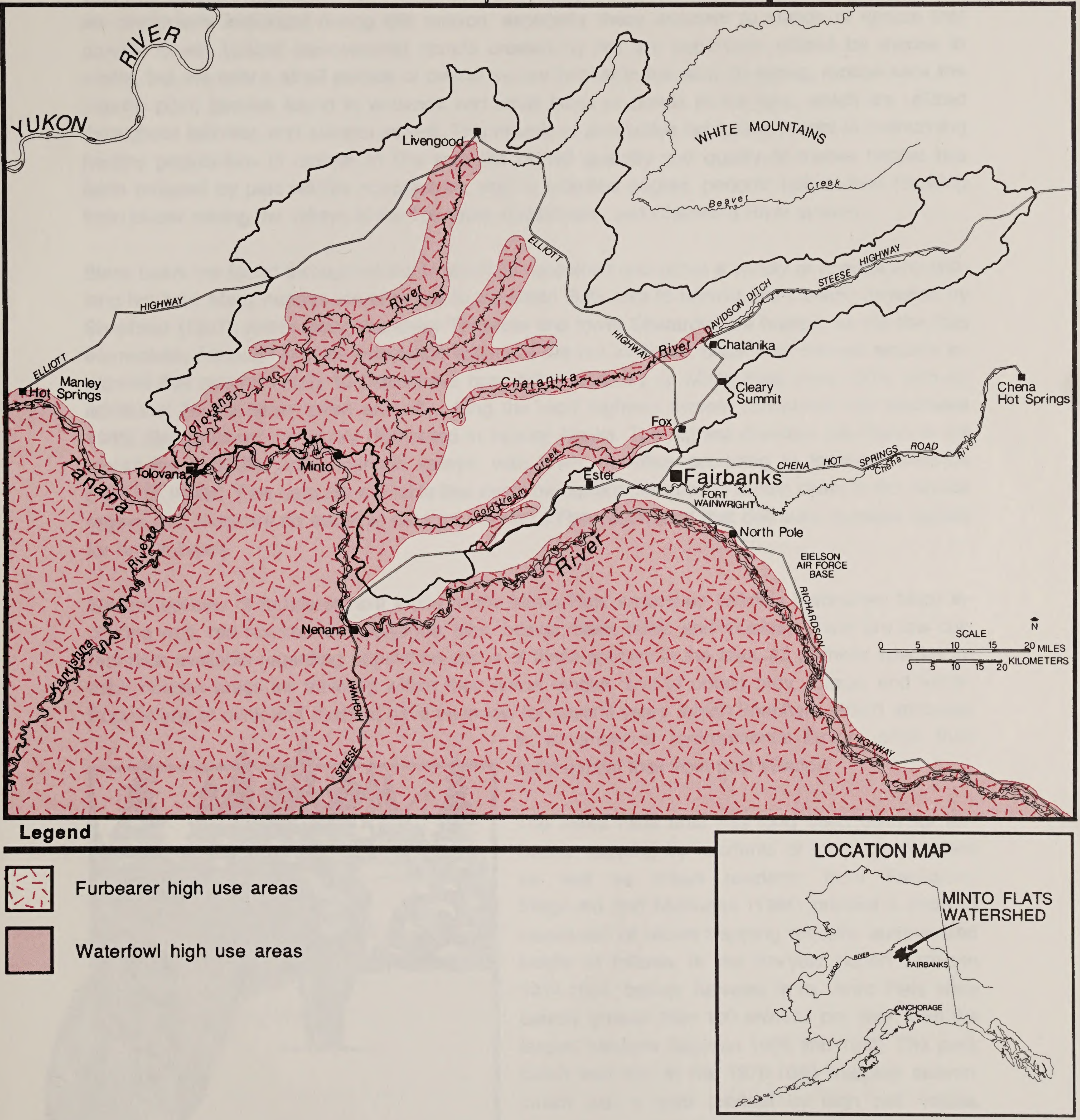
Wildlife

1 of 2

Waterfowl and Furbearers


YUKON
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Livengood
WHITE MOUNTAINS
Beaver
Creek
ELLIOTT
HIGHWAY
River
STEESE
HIGHWAY
DAVIDSON DITCH
HIGHWAY
River
Chatanika
ELLIOTT
Manley
Hot Springs
Chatanika
Cleary
Summit
Fox
Chena
Hot Springs
Tolovana
Tolovana
Minto
Tanana
CHENA HOT SPRINGS ROAD
Chena
River
Ester
Fairbanks
FORT
WAINWRIGHT
Creek
Goldstream
North Pole
River
EIELSON
AIR FORCE
BASE
River
Nenana
RICHARDSON
HIGHWAY
HIGHWAY
STEESE
Kantishna
River
N
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS
Legend
Furbearer high use areas
Waterfowl high use areas
LOCATION MAP
MINTO FLATS WATERSHED
YUKON RIVER
FAIRBANKS
ANCHORAGE

sity, hunting pressure, and land use. During winter months, moose in the area rely heavily upon wetland and riparian vegetation. Early successional communities such as those dominated by willows are particularly important during this season, especially those adjacent to stands of spruce that provide cover. Upland successional stands created by fire are commonly utilized by moose in winter, but are only a small portion of overall moose habitat in the area. In spring, moose seek the aquatic plant species found in wetlands and small lakes or ponds in the flats, which are utilized throughout summer, and autumn as well. This mosaic of productive habitats is crucial in maintaining healthy populations of moose. In this area the overall quantity and quality of moose habitat has been reduced by past wildfire suppression, and to a limited degree, periodic habitat loss resulting from placer mining the valleys of the Tolovana, Goldstream, and Chatanika River system.

Black bears are found throughout the Minto Flats watershed and utilize a variety of riparian and wetland habitats. Many hunters are attracted to the Minto Flats area to harvest black bears, as noted by Shepherd (1987). Areas along the lower Tolovana and lower Chatanika are hunted, as are the flats themselves. Although specific population estimates are not available, black bear harvest records indicated that approximately 10 bears have been taken annually on Minto Flats since 1974, with an additional 20- 30 bears taken annually along the local highway system (Shepherd and Matthews 1985). Brown bears are widely distributed in Interior Alaska. The highest densities are found in the mountains, foothills, and mountain valleys, with lower densities occurring in forested lowlands (ADF&G 1986a). Few data are available that describe current densities of brown bears in the Interior region, and there are no available data for the Minto Flats watershed that delineate essential habitat for brown bears.

Several species of furbearers are found in the Minto Flats watershed (Wildlife Furbearers Map) including wolf, red fox, marten, wolverine, lynx, beaver, otter, mink, and muskrat. There are few current data available regarding population status of these species in the area. All of these species inhabit riparian areas for traveling within their home ranges, and to obtain prey, forage, and water. Populations of mink and muskrat have been low for several years, which Shepherd (1987) attributes to a variety of environmental factors other than local habitat loss from past siltation.

Red Fox

The Minto Flats area has long been used for furbearer trapping by residents of local communities as well as urban residents from Fairbanks. Shepherd and Matthews (1985) present a detailed discussion of recent trapping records, summarized briefly as follows. In the ten-year period between 1974-1984, beaver harvests from Minto Flats were usually greater than 100 animals per year, with the largest harvests between 1976 and 1982. The peak catch was 452 in the 1979-1980 trapping season, which was a year marked by high pelt values. Lower harvest from more recent years is thought to be indicative of low pelt values and revised harvest regulations rather than reduced populations of beaver. The figures for otter harvest tend to reflect the trends for beaver, which is in part because otter are taken in the same snares set for beaver.

The Minto Flats wetlands area includes some of the most productive waterfowl habitat in Alaska (Wildlife Waterfowl Map) and North America as well. Waterfowl generally arrive in this region in April or May before breakup and remain through freeze- up in October (USFWS 1964). The U.S. Fish and Wildlife Service waterfowl surveys estimate that more than 12 million ducks were present on the flats during the 1987 breeding season, with an average density of 120 per square mile. These surveys include mallard, black duck, gadwall, American widgeon, green-winged teal, blue-winged teal, shoveler, pintail, redhead, canvasback, scaup, ring-necked duck, goldeneye, bufflehead, oldsquaw, eider, scoter, ruddy duck, and merganser. They also include Canada goose, trumpeter swan, and sandhill crane (Conant and Roetker 1987). During autumn migration, tundra swans feed and rest on the Minto Flats wetlands. Of particular national significance is that the numbers of pintails are increasing in Alaskan breeding areas such as Minto Flats, while they are concurrently declining in the continental area. The trumpeter swan, another species of national interest, is also showing improved production in this and other waterfowl breeding areas in Interior Alaska. In early summer 1987, total duck populations in Interior breeding areas were expected to increase above the totals for 1986. No data exist concerning discussion of possible reasons or significance the population fluctuations.

Several species of raptors occur in the Minto Flats watershed (Wildlife Raptors Map), including bald eagle, golden eagle, red- tailed, harlan's and sharp-shinned hawks, goshawk, merlin, kestrel, and the endangered Peregrine falcon.

3.6.2 Present Situation in Relation to Mineral Development

Construction of 41.2 miles of permanent gravel roads excluding the Steese Highway, Elliott Highway, and other primary roads has resulted in the loss of 250 acres of wildlife habitat in the Minto Flats watershed. Permanent gravel roads directly associated with federal mineral development total 29.8 miles (181 acres), and those directly associated with State and private mineral development total 11.4 miles (69 acres). The level of vehicular use on roads and trails (excluding the Steese Highway, Elliott Highway, and other primary roads) has caused low and minimal alteration, disturbance, or disruption of wildlife movement routes, and seasonal use areas.

Improvement of access trails and roads into the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas has indirectly resulted in increased harvest of moose, caribou, grizzly bear, black bear, furbearers, and other species. Improving or establishing new access for mining, recreation, and other activities in remote areas has indirectly facilitated more habitat loss and disturbance in wildlife use areas over the long term by enhancing the feasibility of mining more and larger areas.

Facilities associated with working mining camps in the Minto Flats watershed have resulted in the long-term loss of 30 acres of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas. Facilities directly associated with federal mineral development total 10 acres, those associated with State and private mineral develop-

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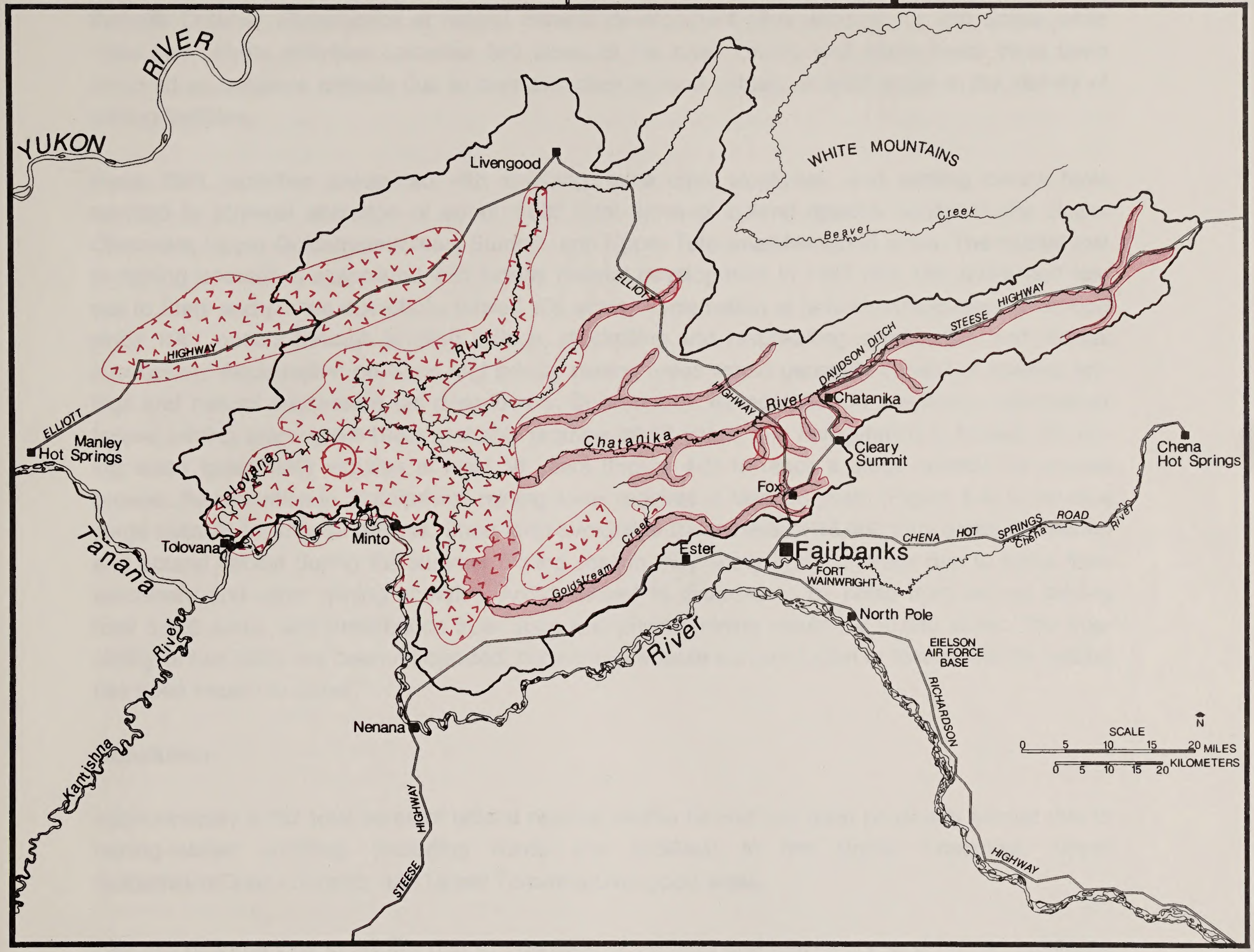
Wildlife 2of2
Raptors and Moose Range


YUKON
RIVER
WHITE MOUNTAINS
Beaver Creek
Livengood
ELLIOTT
HIGHWAY
River
ELLIOTT
Manley Hot Springs
Tolovana
Tanana
River
Kantishna
Tolovana
Minto
Chatanika
River
Chatanika
DAVIDSON DITCH
STEESE HIGHWAY
Cleary Summit
Fox
Chena Hot Springs
CHENA HOT SPRINGS ROAD
Chena River
Goldstream Creek
Ester
Fairbanks
FORT WAINWRIGHT
North Pole
EIELSON AIR FORCE BASE
RICHARDSON HIGHWAY
River
Nenana
STEESE HIGHWAY
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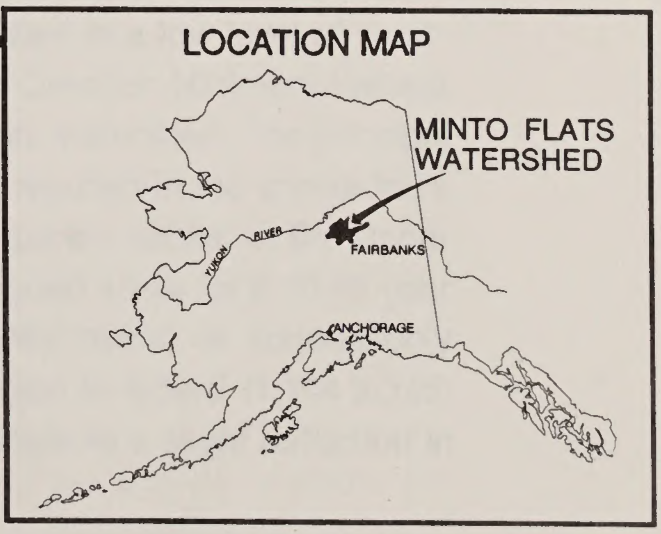
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS

Legend

▨ Moose winter range

▨ Moose high use areas

○ Known raptor nesting habitat


LOCATION MAP
MINTO FLATS WATERSHED
YUKON
RIVER
FAIRBANKS
ANCHORAGE

ment total 20 acres. Similarly, 540 acres of riparian habitat used by moose and other species would be unavailable for the short term due to frequent human disturbance at mining camps from May through October. Disturbance at federal mineral development sites account for 180 acres, while State and private activities comprise 360 acres of the total. Grizzly and black bears have been removed as nuisance animals due to their attraction to food, refuse, or solid waste in the vicinity of mining facilities.

Since 1981, activities associated with stripping, mine cuts, stockpiles, and settling basins have resulted in physical alteration of about 4,002 total acres of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas. The habitat lost to mining operations associated with federal mineral development in 1987 was 155 acres, and losses to State and private operations totaled 105 acres. Reclamation of federal mining areas disturbed since 1981 occurs through leveling tailings, stockpiling and respreading overburden, and natural succession. Reclamation on State and private mining areas would generally consist of leveling tailings and natural succession (as described in Section 2.3). Revegetation in previously undisturbed federal mining areas (post-1980) probably requires 30-50 years, and revegetation in federal old tailing areas (post-1980) requires at least 50 years (Figure 4-3) to reach a stage suitable for moose browse. Revegetation in State/private mining areas requires at least 50 years (Figure 4-3) to reach a stage suitable for moose browse. Short-term avoidance by animals of 15,060 total acres of riparian and upland habitat during the summer mining season may occur in these areas due to noise from machinery and other mining activities. Areas subject to disturbance by noise from federal mining total 5,020 acres, and disturbance from State and private mining would be 10,040 acres. The possibility of fuel spills has been recognized, but no appreciable contamination or loss of wildlife habitat has been known to occur.

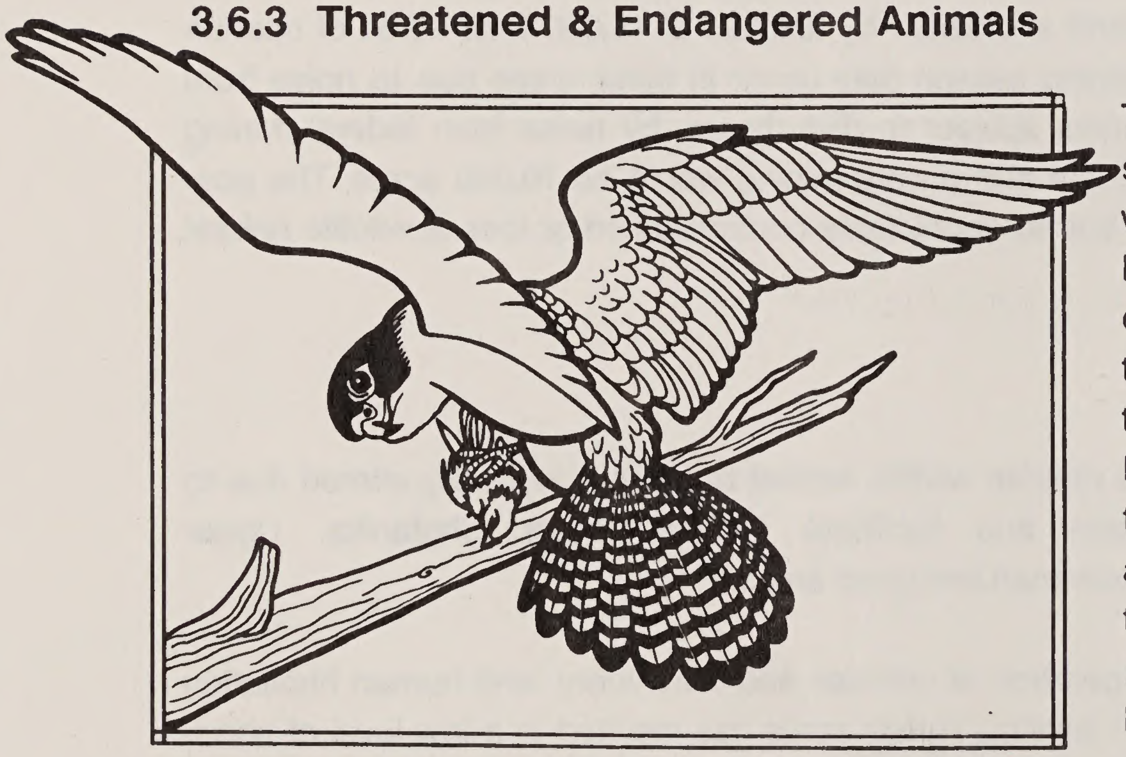
Conclusion

Approximately 4,282 total acres of upland riparian wildlife habitat has been physically altered due to mining-related activities (including roads and facilities) in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas.

Periodic disturbances to wildlife due to operation of vehicles and machinery, and human habitation at mine sites in the Minto Flats watershed totaling 15,600 acres has resulted in a low level of short-term adverse effects in localized areas, particularly during May through October. Minimum harvest of wildlife as a direct result of mining activities is anticipated in Minto Flats watershed. The principal long-term adverse effect of mining in Minto Flats watershed in 1987 has resulted in the unavoidable loss (even with reclamation) of approximately 947 acres of the upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas for a 30-50 year period. Approximately 1,354 acres of this area would remain permanently barren or support only sparse vegetation after reclamation. The long-term cumulative loss of habitat to federal (1,104 acres) and State/private (736 acres) mining activities in these areas may contribute to a slight reduction in moose population potential.

Additional alteration of habitat in the Minto Flats watershed occurred in the early decades of placer mining in the upstream drainages. In particular, the use of hydraulic mining techniques resulted in an estimated 100 million cubic yards or more of overburden being washed into the Chatanika River and Goldstream Creek from the early 1920's to 1963. This greatly hastened the depositional processes that were occurring naturally in these drainages. The specific effects of this accelerated deposition, described in detail in Shepherd (1987), and Shepherd and Matthews (1985), indicate that the major changes included the shallowing and eutrophication of Minto Lake sometime after 1928 when Goldstream Creek filled the lake inlet channel. The creek eventually breached into Little Goldstream and subsequently created new meanders and filled in some smaller lakes with its sediment load. Shepherd (1987) indicates that while some change and loss of prime wildlife habitat is related to the past deposition of mining silt, such effects are largely limited to Minto Lake and the portions of the Tolovana River lakes area. Furthermore, the associated loss of some muskrat habitat is not considered to have been a significant influence on muskrat populations. Some of the effects of infilling may have actually benefited such species as moose and certain waterfowl. Shepherd basically concludes that the heavy siltation from past mining operations has had little negative impact on wildlife, and has possibly improved some habitats for certain species.

3.6.3 Threatened & Endangered Animals



Peregrine Falcon

The only threatened or endangered species present within the Minto flats watershed is the Peregrine falcon. Peregrine falcons nest in the boreal forest of Interior Alaska where historic populations were quite substantial, especially in the Yukon, Porcupine, and Tanana river basins. The Minto Flats watershed contains areas of suitable nesting habitat along streams and upland areas, with one to three breeding pairs present annually (Wildlife raptors map). Nesting sites have been identified within the Minto Flats watershed and have been monitored annually (Durtsche, pers. comm.). The regional population of the Peregrine appeared to be quite stable until the mid-1960's, except for local minor reductions in numbers (USFWS 1982). By 1970, a rapid decline in the population was evident. Data suggest that the principle cause for this was due to chlorinated hydrocarbons (ddt metabolites). High concentrations of these pesticide residues in breeding peregrines resulted in eggshell thinning and ultimate reduction in productivity. The birds obtained the pesticide from contaminated prey located on breeding areas, and wintering areas, and routes to and from their wintering areas in Central and South America. Other factors contributing to the the overall reduction in breeding populations were egg collection, human-caused disturbances, and habitat destruction.

Because of strict pesticide control and protective management nationwide, the overall population of the Peregrine falcon has been steadily increasing over the last few years. Breeding pairs in the main nesting areas in Interior Alaska are close to historic numbers, and it appears the population is approaching the levels needed to allow dispersal into other drainages where re-occupation of historic nest sites and other nesting habitat is occurring (Ambrose, pers. comm.). Maintenance and protection of this breeding habitat is a basic step towards establishment of a self sustaining population (USFWS 1982).

3.7 Fisheries

3.7.1 Minto Flats Complex

Sections of the Chatanika River, Tolovana River, and Goldstream Creek within the Minto Flats complex will be discussed here, but the detailed discussion of these streams follows in separate subsections which cover their entire drainage areas.

Anadromous and resident fish species occur within the Minto Flats complex (ADF&G 1987a). The Alaska Department of Fish and Game has conducted research in this complex for many years, so data concerning fish species are well documented. Fish species reported in the Minto Flats complex includes chinook salmon, chum salmon, coho salmon, arctic grayling, round whitefish, humpback whitefish, broad whitefish, least cisco, sheefish, northern pike, longnose sucker, burbot, blackfish, and possibly slimy sculpin.

Species description and distribution maps for most species can be found in "Alaska's Fisheries Atlas" (ADF&G 1978a,b). The data collected for Minto Flats anadromous and resident fish species address mainly summer distribution and some winter studies using monitoring radio tags.

The majority of salmon observed in Minto Flats, lower Tolovana, and Chatanika Rivers complex are upstream migrating adults and out-migrating smolts (ADF&G 1987a). Small tributary streams of the Tolovana River have been documented to support rearing salmon (ADF&G 1987a).

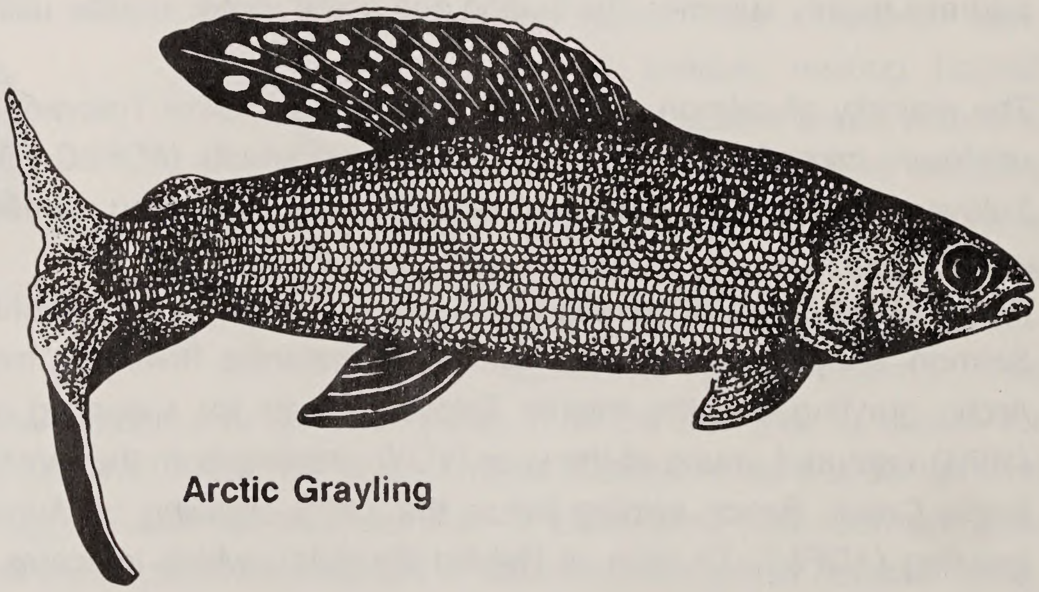
Resident fish species use the Minto Flats complex for migrations, spawning, rearing, and wintering. Salmon species use the Tolovana and Chatanika Rivers as migration routes to spawn upstream. Arctic grayling use the middle Tolovana River for spawning and rearing; Townsend and Robus (1984) captured young-of-the-year (YOY) grayling from the mouth of Rosebud Creek downstream to Eagle Creek. Beach seining below the TAPS crossing on August 7, 1985 yielded 62 mostly YOY grayling (ADF&G, Division of Habitat file data), which indicates spawning occurs in this portion of the system.

Broad whitefish are widespread in the lower Tolovana, Chatanika, and Tatalina Rivers during the summer months. Humpback whitefish and least cisco use the lower Tolovana and Chatanika Rivers, lower Goldstream Creek, and the extensive Minto Flats lake and slough system as summer feeding (Alt 1980). Adult fish leave Minto Flats in early July for spawning areas in the middle reaches of the Chatanika where they spawn from late September to mid-October (Alt 1980).

Sheefish enter the Flats from the Tolovana and Tanana Rivers in late May after breakup, and use the extensive lake, river, and slough system as their main feeding and rearing areas (Alt 1968, 1977). In late June, the spawning population begins migrating up the Chatanika River and reach their spawning areas in the middle segment of the river in late August and September (Alt 1977). Some may spawn in the lower Chatanika River (Alt 1969).

Northern pike is the species most often associated with Minto Flats, and the lower Tolovana River is an important component of its habitat. The southeastern section of the Flats, encompassing Big Minto Lake, the lower Chatanika River, and Goldstream Creek also support large numbers of pike throughout the year (Cheney 1971, Holmes pers. comm. 1987). Northern pike spawn in Minto Flats between May 10 and June 16, with peak spawning occurring in the last week of May (Cheney 1971, Alt 1969). Also, northern pike spawning occurs in the lower reaches of Rock Island Slough and the Windy Lake/Uncle Sam Creek/Montana Creek complex, as well as in the Chatanika River and Minto Lake areas.

Wintering areas exist throughout the Minto Flats complex. Arctic grayling are known to pass through Minto Flats in the spring (Townsend and Kepler 1974), presumably from wintering areas in the lower Tolovana and Tanana Rivers. Broad whitefish winter in the lower Tanana, Chatanika, and Tolovana Rivers (Alt 1972). Humpback whitefish and least cisco are likely to winter in the lower Tolovana and Tanana Rivers (Alt 1972). Minto Flats sheefish winter in the lower Tolovana and Tanana Rivers, as much of the water in Minto Flats becomes oxygen deficient during the winter months (Alt 1977, Cheney 1972). Northern pike winter in several areas of Minto Flats. Radio tagging studies in 1982 and 1987 showed that Swanneck Slough, Grassy Slough, and the lower Tolovana and Chatanika River areas are used by pike for wintering. The attached map delineates these areas (ADF&G 1987a, Figure 2).



Arctic Grayling

There are no data on macro invertebrate sampling for Minto Flats. Also, baseline data are not sufficient to determine if or what extent fishery resources in Minto Flats have been affected by sediment from placer mining (ADF&G 1987a). Elevated turbidity may have a direct physical effect on fish in the lower portions of Goldstream Creek at Minto Flats. High sediment levels may affect fish popula-

Minto Flats Placer Mining

Fisheries

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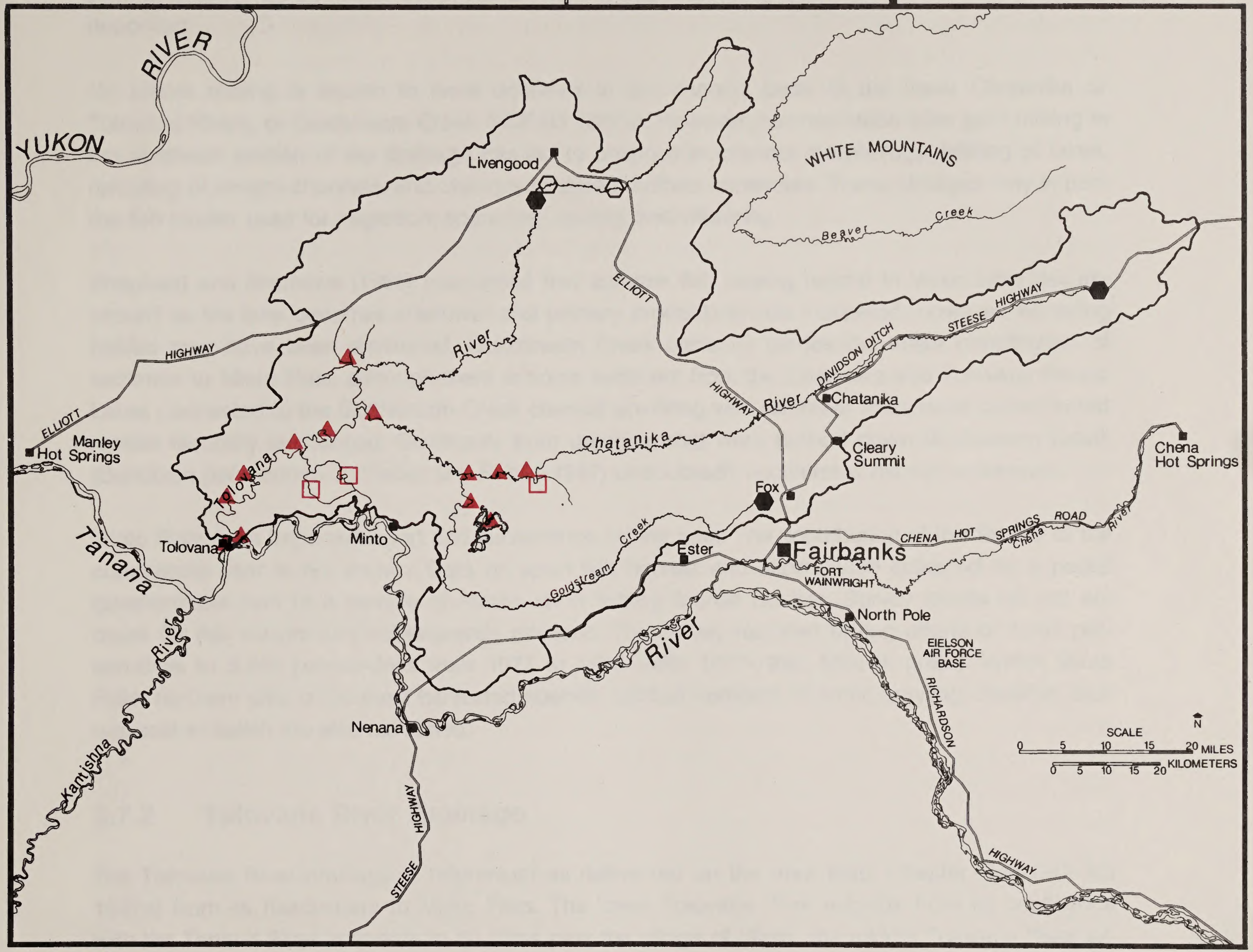
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STEESE HIGHWAY
DAVIDSON DITCH
River
Chatanika
ELLIOTT
Manley Hot Springs
Tolovana
Chatanika
Cleary Summit
Chena Hot Springs
Fox
Tanana
Tolovana
Minto
Creek
Goldstream
Ester
Fairbanks
FORT WAINWRIGHT
CHENA HOT SPRINGS ROAD
Chena
River
River
North Pole
EIELSON AIR FORCE BASE
RICHARDSON
River
Nenana
Kantishna
HIGHWAY
STEESE
HIGHWAY
N
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS

Legend

Overwintering areas data obtained from radio-tagged pike

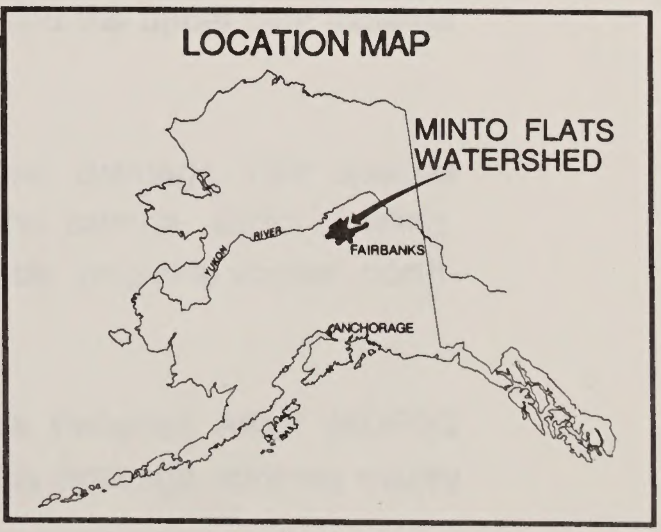
▲ December 1987

□ March 1983

Representation of some water quality monitoring stations

⬢ Automated site

⬡ Non-automated site


LOCATION MAP
MINTO FLATS WATERSHED
YUKON
RIVER
FAIRBANKS
ANCHORAGE

tions by altering the lake or stream habitat (ADF&G 1987a). Changes in lake habitat resulting from sedimentation may be either beneficial or detrimental, depending upon the amount of sediment deposited.

No placer mining is known to have occurred in the channel beds of the lower Chatanika or Tolovana Rivers, or Goldstream Creek (ADF&G 1987a). However, sedimentation from gold mining in the upstream portion of the drainage has led to changes in channel morphology, infilling of lakes, rerouting of stream channels, and changes in stream bottom substrates. These changes may impact the fish habitat used for migration, spawning, rearing, and wintering.

Shepherd and Matthews (1985) speculated that summer fish rearing habitat in Minto Lake has improved as the lake becomes shallower and primary productivity has increased; however, wintering habitat may have been eliminated. Goldstream Creek currently carries the major contribution of sediment to Minto Flats, although there is some sediment from the Chatanika and Tolovana Rivers. Lakes connected to the Goldstream Creek channel are filling with sediment while lakes unconnected remain basically unchanged. Sediments from dredging that were flushed down Goldstream Creek (Bundtzen pers. comm. in Weber and Robus 1987) undoubtedly accelerated natural processes.

Minto Flats is an important sport and subsistence fishing area. The contribution of this fishery to the commercial user is not known. Data on sport fish harvest and efforts were collected by a postal questionnaire sent to a sample of Alaska sport fishing license holders. Survey results do not account for fish caught and subsequently released. The survey reported fishing efforts of 1,281 person-days to 3,886 person-days from 1977 to 1986 (Mills 1977-1986, Mills in prep.). Within Minto Flats, northern pike is the most harvested species. Limited numbers of arctic grayling, sheefish, burbot, and whitefish are also harvested.

3.7.2 Tolovana River Drainage

The Tolovana River drainage is referenced as delineated on the Area Map, Chapter One (ADF&G 1987a) from its headwaters to Minto Flats. The lower Tolovana River extends from its confluence with the Tanana River upstream to 20 miles past the village of Minto; the middle Tolovana River extends from 20 miles past Minto upstream to the Elliott Highway Bridge; and the upper river extends upstream from the bridge.

Anadromous and resident fish species occur within the Tolovana River drainage. Fish species reported in this drainage include chinook salmon, chum salmon, coho salmon, arctic grayling, round whitefish, humpback whitefish, broad whitefish, least cisco, sheefish, longnose sucker, northern pike, burbot, and slimy sculpin.

Species description and distribution maps can be found in "Alaska's Fisheries Atlas" (ADF&G 1978a,b) for most species. Survey data collected for fish species in this drainage address mainly summer distributions.

Chinook, chum, and coho salmon that use the lower Tolovana River are adults migrating upstream to the Chatanika River spawning areas. Also, salmon have been reported 17 miles upstream in the Tolovana River above the Chatanika River confluence, but this has not been verified (Townsend, pers. comm. 1988).

Anadromous and resident fish species use the Tolovana River drainage for migration and access to spawning, rearing, and overwintering areas. Salmon reportedly use the drainage as stated above. Limited data exist on fish species use of the tributaries in the Tolovana River drainage for spawning, rearing, and overwintering (ADF&G 1987a). Townsend and Robus (1984) captured YOY grayling from the mouth of Rosebud Creek, thus establishing the species presence in this river system. Their sampling below the TAPS crossing yielded mostly YOY grayling, which indicates spawning occurs in this portion of the stream. Such areas may also be used as feeding sites. Grayling have been collected from the river, Livengood Creek, Wilbur Creek, Lost Creek, and Duncan Creek (ADF&G 1987a).

Several resident fish species use the Tolovana River drainage for summer rearing and feeding or to move to spawning areas in the fall. Humpback whitefish and least cisco use the river for summer feeding (Alt 1980) and occur as far upstream as the TAPS crossing (ADF&G 1987a).

Sheefish leave the Tanana River and move up the Tolovana River after spring breakup to their summer feeding and rearing areas (Alt 1968, 1977). Northern pike spawn as far upstream as Rock Island Slough and Windy Lake/Montana Creek complex (De Cicco, pers. comm. 1988).

Fish avoidance of specific tributary streams is primarily due to physical conditions that limit or preclude fish passage into the upper portions of the river (ADF&G 1987a). These physical changes consist of channel changes, instream settling ponds or dams, ditching, road construction, and perched culverts (ADF&G 1987a). Several tributary streams of Livengood Creek, which drains into the Tolovana River, contain these obstructions to fish passage. In 1986, several debris dams were observed in the lower reaches of Livengood Creek; however, none of these dams appeared to obstruct fish passage (ADF&G 1987a). There are also several other streams of the middle and upper segments of the Tolovana River that contain these physical obstructions; some block fish movements while others allow limited passage.

Overwintering areas exist primarily in the lower Tanana/Tolovana Rivers. Overwintering fish have been sampled in the upper portions of the Tolovana River near Duncan Creek (ADF&G 1987a). It appears that these overwintering areas may be in short supply in the middle and upper drainage areas. Grayling, northern pike, broad whitefish, humpback whitefish, least cisco, and sheefish are reported to use these available overwintering areas (ADF&G 1987a). The ADF&G sampled many of the streams in the upper segment of the Tolovana River for macro invertebrates (ADF&G 1987a). Invertebrates collected were copepods, midges/blackflies, mayflies, aquatic leeches, water mites, round worms, aquatic earthworms, stoneflies, and caddisflies (ADF&G 1987a). These invertebrates could be considered representative for the Tolovana River drainage. Macro invertebrates were not sampled from stream reaches directly below active placer mining, so the effects of active mining to the invertebrate populations could not be determined (ADF&G 1987a).

Water quality for the Tolovana River drainage taken by ADEC and ADF&G (1987a) measured turbidity, total suspended solids, total dissolved solids, settleable solids, stream flows, temperatures, alkalinity, substrate conditions, and heavy metals. Evaluations were not made on the overall water quality for the Tolovana River. Water quality parameters for each of tributary streams must be considered on a case-by-case basis in making an evaluation.

Data on the use of the Tolovana River drainage for sport fishing have been presented in the document on Minto Flats. This data is primarily for the lower Tolovana River. To date, there is little information on the use of the upper portion of the Tolovana River drainage for sport fishing (ADF&G 1987a).

There appears to be substantial change to the physical habitats of the aquatic environment from mining in the Tolovana River drainage (ADEC 1987a, ADF&G 1987a). Placer mining affected stream habitat through changing the stream channels, reducing pools and undercut banks, creating stream blockage from instream settling ponds and diversion dams, and eliminating riparian vegetation.

Deposition of silt and sediment on the stream substrate, from past and active placer mining, could limit or reduce use of these waters for macro invertebrate production, spawning, feeding, and migration.

3.7.3 Chatanika River Drainage

Reference to the Chatanika River drainage is based on the three segments of its physical characteristics as delineated by ADF&G (1987a).

Lower Chatanika River - from its mouth upstream to the upland marking the eastern boundary of Minto Flats.

Middle Chatanika River - from the eastern boundary of Minto Flats upstream to Sourdough Creek.

Upper Chatanika River - the upper section extending upstream from Sourdough Creek.

Anadromous and resident fish species occur within the Chatanika River drainage. Data gathered by ADF&G are detailed and well documented for fish species that use this drainage. Species present include all anadromous species present in the Tolovana River, plus the resident species arctic lamprey and lake chubs.

Species description and distribution maps for most species can be found in "Alaska's Fisheries Atlas" (ADF&G 1978a,b). The data collected for the Chatanika River fish species addresses the summer distribution and some winter studies using monitoring radio tags.

ADF&G surveys indicate that chum salmon is the most numerous species, then chinook salmon, and then an occasional observation of coho salmon (ADF&G 1987a). Chinook and chum salmon spawn in the Chatanika River from the Chatanika Dam downstream to a point approximately six miles upstream from the Minto Flats eastern boundary with the river. Some chinook salmon have been observed spawning at Steese Highway miles 31 and 60 (DOI 1963).

Rearing chinook are found in the same reach of stream as stated above and in the lower reaches of its tributaries (ADF&G 1987a). Fry and smolts of coho salmon have been collected at several locations below Steese Highway mile 40 (DOI 1963), but movement upstream by adults to spawning locations are not described (ADF&G 1987a).

Little data are available on round whitefish in the Chatanika River. Broad whitefish are widespread in the Minto Flats complex, entering it in June from wintering areas in the lower Tanana, Tolovana, and Chatanika Rivers (Alt 1972, Kepler 1973).

Least cisco appear to be the most numerous of the whitefish species in the Chatanika drainage. They spend the spring and summer in Minto Flats complex, then move upstream in the Chatanika to spawning areas in July, nine miles below to seven miles above the Elliott Highway Bridge (Alt 1980, Kepler 1973). Adults move downstream to wintering areas after spawning.

Humpback whitefish follow a life cycle similar to that of the least cisco in this drainage. Adult fish leave the Minto Flats complex in early July for spawning areas in the middle reaches of the Chatanika where they spawn in September and October (Alt 1980). The numbers of this species spawning in the river in 1987 was estimated to be 29,270 (Hallberg & Baker 1987).

The non-anadromous sheefish winter in the lower Tanana and Tolovana Rivers. In late May, following breakup, they use the Flats complex as their main feeding and rearing areas (Alt 1968, 1977). In late June they move up the Chatanika River and reach the spawning areas in the middle of the river in late August and September (Alt 1977). After spawning, sheefish then move downstream to wintering areas.

Northern pike are found year-round in the Chatanika River, especially in the lower and middle segments of the river. Pike move to shallow areas with emergent vegetation to spawn in the spring (Cheney 1971). Spawning begins in early May and continues through June (Cheney 1971). Adult northern pike winter in the lower Tanana and Tolovana Rivers. Some winter in the Chatanika River and areas of Minto Flats that have sufficient flows and dissolved oxygen content (Hallberg 1984).

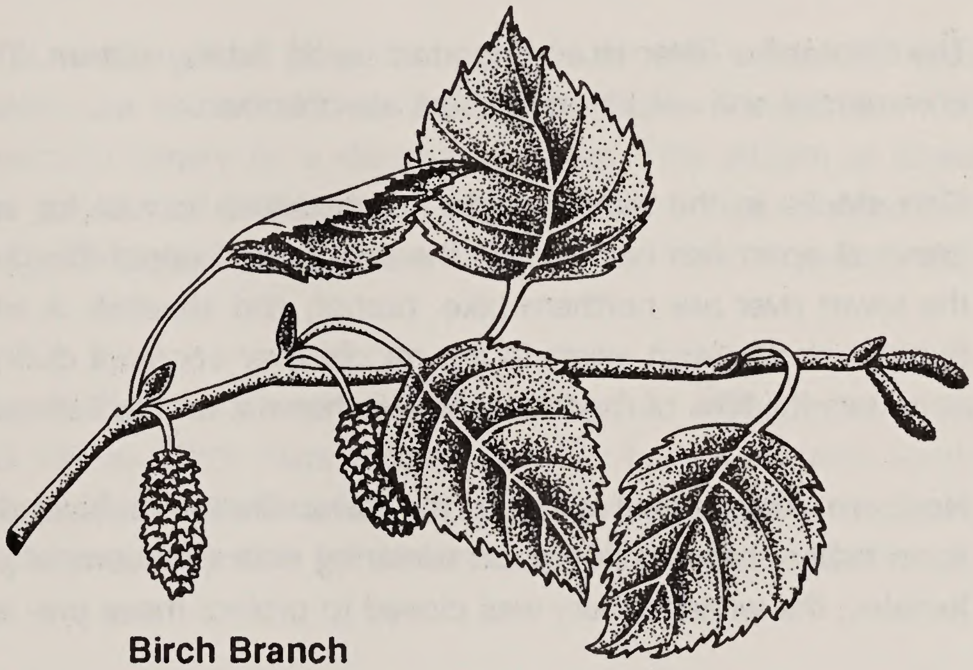
Grayling are found throughout the Chatanika River drainage, from its headwaters, and at McManus and Sourdough Creeks to its mouth (Hallberg 1982; Homes 1983, 1985; Tack 1973; DOI 1963). They enter the spawning areas at spring breakup when the streams are near flood stage (Tack 1980). After spawning, they disperse to summer feeding areas with the adults selecting upstream reaches of the tributary streams. In late autumn, grayling move out of feeding areas to wintering areas in the drainage.

Some grayling wintering was reported in the Faith and McManus watersheds of the upper Chatanika drainage (DOI 1963). Also, it is known that some grayling pass upstream through Minto Flats in the spring (Townsend and Kepler 1974), presumably from wintering areas in the lower Tanana and Tolovana Rivers.

A small population of non-anadromous arctic lamprey are known to spawn in the Chatanika River a few miles below the Elliott Highway bridge (Morrow 1980).

Fish movements in the upper segment of the river have been reduced by the Davidson Ditch structure. Past levels of mining possibly had a greater impact on fish populations than does current mining, especially when the ditch was operating and causing several creeks of the upper river to go dry (ADF&G 1987a). Fish died when they found their way into the ditch and associated structures (ADF&G 1987a).

Also, the Chatanika diversion dam, located a little less than a mile downstream from the mouth of Faith Creek, serves as a barrier to free upstream movement of fish. The effect of the dam on fish distribution in the upper segment of the river and its headwaters is not known (ADF&G 1987a). Salmon and whitefish are not known upstream past the dam, although many whitefish (presumably round whitefish) have been taken below the dam and in Sourdough Creek (DOI 1963).


Birch Branch

Limited macro invertebrate studies have been conducted within the Chatanika River drainage (ADF&G 1987a), all for the upper river segment (Maurer 1987, Wagener and LaPerriere 1985). Maurer (1987) collected macro invertebrates that included cranes, midges, blackflies, mayflies, snails, water mites, round worms, aquatic earthworms, stoneflies and caddisflies. These invertebrates could be considered representative for most of the Chatanika River drainage.

Some water quality samples associated with placer mining have been collected in the Chatanika River drainage. Most samples were collected from the mined Faith and the unmined McManus Creeks. Some of the parameters recorded were turbidity, total suspended solids, total dissolved solids, settleable solids, stream flows, temperatures, alkalinity, pH, total and calcium hardness, and heavy metals. An ISCO automatic water sampler was placed in Faith Creek by ADF&G and ADNR in 1986 and 1987, above the Steese Highway, to monitor water quality continuously; however, ADF&G has not yet analyzed this data. Evaluations were not made on the overall water quality for the Chatanika River and its upper segment.

Placer mining has reduced the quality of fish habitat in several of the streams in the Chatanika River drainage by channelization, sedimentation, excavation of the streambed substrate, removal of riparian vegetation, installation of instream dams, and removal of water from streams (Bjerklie & LaPerriere 1985, Townsend 1987, Townsend pers. comm. 1987, DOI 1963, Watson 1957). These streams include the Chatanika River, and Faith, Hope, Charity, Homestake, Sourdough, Cleary, Little Eldorado, Dome, Any, and Belle Creeks.

Placer mining on Faith Creek and its tributaries produced elevated levels of turbidity in water samples collected in the Chatanika River near Poker Flats. Turbidity levels measured at Poker Flats site ranged from less than 1 NTU to 110 NTUs during sampling in 1984, 1985, and 1986 (ADF&G 1987b).

Increased turbidity from placer mining in the river interfered with, or prevented fish survey projects for salmon and whitefish during 1980, 1983, 1984, and 1985 (Barton 1984, Holmes 1986, Kramer 1981). Creel census surveys suggest that many anglers may have avoided participation in the Chatanika River whitefish spear fishery during seasons when turbidity levels were elevated because of placer mine effluent; anglers that participated were less successful (Townsend 1987).

The Chatanika River is an important sport fishing stream. The contributions of the fish resource to commercial and subsistence users are unknown.

Fish stocks in the river provide a substantial harvest for sport fishing (ADF&G 1987a). The chief areas of sport fish harvest are the middle and upper Chatanika River. The main species caught in the lower river are northern pike, burbot, and sheefish. A whitefish spear fishery of least cisco and humpback whitefish exists in the middle river segment during September and October. This fishery accounts for 70% of the total whitefish harvest for the Tanana River drainage (Mills in prep.).

Northern pike are harvested in the lower Chatanika River during the summer. Also, a large winter sport fishery has developed on wintering concentrations of pike. Since 90% of the pike caught were females, the winter fishery was closed to protect these pre- spawning females (ADF&G 1987a).

The cumulative effects of placer mining in this drainage have reduced the amount of fish habitat available to resident and anadromous species. Channelization of streams, and mining of banks and streambeds, has reduced summer feeding habitat for fish and possibly spawning or wintering habitat as well (ADF&G 1987a).

3.7.4 Goldstream Creek Drainage

Discussion of the affected environment for Goldstream Creek drainage pertains mainly to Goldstream Creek and its headwater tributary streams, Pedro and Gilmore Creeks.

Resident fish reported to occur in the drainage are arctic grayling, least cisco, broad whitefish, humpback whitefish, sheefish and northern pike. The description and distribution maps for most species can be found in "Alaska's Fisheries Atlas" (ADF&G 1978a,b). Fishery survey data collected on resident species addresses summer distribution.

Fish in the lower reaches of the drainage were sampled by hook and line and a gill net by Weber and Robus (1987). They captured least cisco and northern pike near Bridge Lake. Additional sampling was conducted in the Pedro, Gilmore, Flume, and Goldstream creeks. The only fish found at these sites, was one grayling in Flume Creek, a tributary of Pedro Creek, in September 1986.

Aquatic habitat is fair to poor in the Goldstream Creek drainage. High stream water turbidities combined with elevated settleable solids levels and resultant deposition on streambeds have probably been major factors responsible for reducing fish populations and angler success. Pedro Creek and Goldstream Creek in the vicinity of Ballaine Road had stream bottom substrate that was almost totally embedded in silt and sand. Aquatic invertebrates, the major food of arctic grayling and any other sight-feeding fish, were not observed in either Pedro or Goldstream Creeks (ADF&G 1987a) during departmental field survey.

Gilmore Creek has a varied substrate of medium-sized gravel to cobble in the riffle areas, and sand and silt in pools. The gravel cobble areas are not embedded. Goldstream Creek downstream from Goldstream Road to Minto Flats appears to largely be a depositional area. This stream at Sheep Creek Road has a streambed of large gravel and cobble in the region of the bridge. Habitat here probably is more suitable for aquatic invertebrates, but no observations were made to substantiate its suitability (ADF&G 1987a).

Much of the sediment load carried by Goldstream Creek has been deposited along most of the stream channel to Minto Flats (ADF&G 1987a). Minto Flats contains key fish habitat required for the life cycle of several fish species. The importance of Minto Flats is stated in its affected environment report and those by ADF&G (1987a). Water quality data for the drainage is reported in Section 3.4 on water quality.

Macro invertebrates samples were collected (Maurer 1987) from Pedro Creek above Gilmore Creek, Gilmore Creek near Nassau Road, and in Goldstream Creek downstream from the Steese Highway. Maurer (1987) sampled these sites from June to October and collected midges, blackflies, mayflies, aquatic earthworms, stoneflies, and caddisflies. These invertebrates can be considered representative for the drainage.

Goldstream Creek has never been considered to be a heavily used area for sport fishing; however, local residents report fishing for arctic grayling in the late 1960's through the mid-1970's, and to a lesser degree, in the early 1980's. Poor water quality is often cited as a reason for the decline in sport fishing (ADF&G 1987a). A resident near Goldstream Creek near the confluence of Moose Creek stated that recent placer mining prevented access to the area where he and his family fished (Pedersen, pers. comm. 1987).

Effects of placer mining on the physical habitats used by fish species in Goldstream Creek and its tributaries have not been quantified (ADF&G 1987a). Physical habitat changes resulted in the loss of stream meanders, pools, riffles, and other habitat features suitable for fish life cycles. Removal of the riparian vegetation may cause streambank instability as well as a decrease in the amount of allochthonous organic nutrients into the stream. These nutrients may serve as a food source for benthic organisms (Haynes 1970).

Fish populations in Goldstream from Sheep Creek Road upstream to the headwater tributary streams appear to have declined since the resurgence of placer mining in the late 1970's (ADF&G 1987a). Anecdotal information suggests that arctic grayling populations were higher in the mid-1970's to early 1980's before placer mining increased significantly (ADF&G 1987a).

The availability data for fish resources in Goldstream Creek is limited; therefore, presentation of the migration, spawning, rearing, feeding, and wintering of fish species in this drainage is not complete.

3.8 Cultural Resources

3.8.1 Prehistory

Artifacts and bones from extinct large mammals have been found by miners since prospecting first started in this drainage. Rainey (1939) reported on several finds made during hydraulic operations in the Fairbanks area. Between 1933 and 1936 two chert points, a "Yuma point," two chert blades, and a stemmed point came out of muck deposits on Goldstream Creek. During the same seasons another "Yuma point" and a chert blade were found frozen in the muck near the bones of mammoth, mastodon, bison, and horse during hydraulic operations on Ester Creek. The rich Ester deposits also yielded a polished slate knife and bone handle, a small stemmed chert point; a splint of horse bone with one end worked into an awl and a flat oval scraper made from a mammoth tusk, both of which were found frozen into the muck; a woman's knife, a small endscraper, and a retouched flake. In 1938, a ground sluicing operation on Cripple Creek uncovered a chert point, and on Little Eldorado Creek, in addition to the large number of faunal remains, an elliptical, crudely flaked scraper or blade was uncovered. Although most of these artifacts could not be positively dated, the probable association with extinct large mammal remains was frequent enough to suggest human presence at an early date in Alaska.

Work by Hopkins (1967) has established that during the late Wisconsin glaciation (maximum extent 18,000 years ago), Alaska and Siberia were part of a single continental land mass known as Beringia. Much of the ice- free interior of Alaska at that time consisted of a steppe-tundra environment (Ager 1975) which supported such animals as bison, horse, and mammoth (Guthrie 1968). Due to the presence of these large game animals, the land presumably supported people.

Work by West (1981) in Interior Alaska has resulted in the definition of an important artifact assemblage known as the Denali complex. This complex is dated between 8,000 and 11,000 years ago and contains such characteristic elements as distinctive wedge-shaped microblade cores, burins made on flakes (Donnelly burins), biconvex bifacial knives, blades and tchi-thos or small scrapers. Components of this complex are geographically widespread in Alaska and have been found near Fairbanks at the University campus site, in Minto Flats at C.O.D. Hill, in Livengood at Rosebud Knob, and in the Birch Creek drainage (Will 1986).

One of the earliest firmly dated Interior Alaska sites, Dry Creek, dates to approximately 11,000 years ago (Thorson and Hamilton 1977). Component I of this site, located along the northern flanks of the Alaska Range, contains cultural material similar to that found in the lowest levels of a site at Healy Lake. This material, known as the Chindadn complex, differs from the Denali complex in that a different form of bifacial projectile or knife is present. Chindadn points date between 9,000 and 11,000 years ago (Cook 1975). A basally-thinned projectile point base discovered during a BLM survey near a tributary of Birch Creek also resembles Chindadn material (John Cook, personal communication 1983).

Although the cultural affinity of these artifacts and their faunal associations have not been confirmed, artifacts in central Alaska which date as early as 11,000 years ago have been found in association with Pleistocene megafauna at such sites as Dry Creek.

An archaeological survey conducted by Schledermann and Olson in 1968 located material on C.O.D. Hill overlooking Minto Flats. Excavation of several test pits uncovered chert waste flakes, a Fairbanks campus-type burin, small broken bones, limestone pebbles, a small obsidian scraper, a crude basalt scraper, and a retouched broken blade fragment. Several pieces of charcoal were also found. The authors felt that the site resembled the material and location of the campus site enough to possibly have a similar date (Schledermann and Olson 1969).

During a brief survey conducted in 1972, a small site consisting of waste flakes was found upstream from the mouth of the Tolovana River. A prehistoric site with waste flakes and an endscraper was also found near the present village of Minto, in addition to a site where bone fragments, endscrapers, microblades, and flakes were found on a recent hunting camp (Andrews 1977).

Occasional artifacts have also been found in the Manley area, including an obsidian biface, several stone arrowheads reported from the early 1900's, a collection of microblades and flakes, and a large chert blade.

Work conducted in the Livengood area during the Trans-Alaska Pipeline project resulted in finding and excavating several archaeological sites. Derry in Cook (1977) has provided a summary analysis of the cultural sites in this area. The earliest use appears to have been between 8,000 and 10,500 years ago during the late Pleistocene-Early Holocene period. This material in the lowest level was found directly above bedrock and below the Ready Bullion loess deposits. It contained microblade cores, burins, a single projectile point, and broad, thin bifaces. There were no microblades or scrapers. The occupants may have been attracted to the area due to the chert outcrops at the edge of a spruce forest and shrub tundra. They also apparently obtained obsidian through trade with people to the west.

There appears to be a continuity into the next period of use, when a wedge-shaped core complex of largely local material appears at several sites throughout the Livengood area. Although the authors do not want to term this the "Denali complex" for several reasons, the material in this layer, which is about 6,000 years old, contained wedge-shaped microblade cores similar to those at the campus site. Burins were also found at this level, in addition to corner-notched and expanding stem points, and a variety of scrapers.

Apparently between 3,500 to 5,000 years ago Tuktu-Palisades Complex material was deposited at the sites. This complex is also found at such widely scattered locations as Anaktuvuk Pass, Healy Lake, and a site near the Jim River on the southern flanks of the Brooks Range. The material is characterized by distinctive Tuktu- type cores, side-notched and lanceolate points, microblade cores with burin blows, and a variety of scrapers. This complex differs from the other two in both artifact form and in the use of non- local material.

Two other sites in the area were quarry/workshops located near chert outcrops that may have been in use up to recent times.

A site, designated CIR-003, along the Steese Highway near the Chatanika River was determined eligible for the National Register of Historic Places (NRHP) in 1979. It was examined by C. Holmes in 1976 (Dilliplane 1978). Although part of the site was perhaps destroyed by Steese Highway work in the 1920's, much of it still remains. Testing during survey on the adjacent ridge uncovered broken caribou bones, some firecracked rock, a chert waste flake, a possible Kavik projectile point, a tchi-tho (spall scraper), and a core tablet. The site has not been firmly dated. The lower part of the site, which has not been tested, consists of a complex of cache pits. Since the area was used by both Tanana and Kutchin people before and at contact with white people, it appears that this site, located in the Tanana-Yukon Uplands at the confluence of a small clearwater stream and the Chatanika River, was probably a hunting/storage site used by Athabaskan people, although whether they were Tanana or Kutchin is unknown. Caribou and/or whitefish, grayling, or salmon may have been harvested and stored at the site. Aboriginal cache pits were also found at the mouth of U.S. Creek (Dilliplane 1980).

A request for a determination of eligibility to the National Register of Historic Places was also submitted for the Minto Historic District (Andrews 1979) and for an old village site located near the confluence of the Tolovana and Tanana Rivers adjacent to the Tolovana Roadhouse (Bowers 1986). The proposed Minto district consists of the historic community of Old Minto Village, located at on the right limit of the Tanana River, west of Minto Lakes; Cache, the location of ten caches constructed of gabled wooden structures supported on four posts, and two cold storage pits at the confluence of Goldstream Creek and Minto Slough; and the Indian Cemetery located on the left bank of Goldstream Creek, approximately seven miles northeast of old Minto Village.

Apart from those sites discussed above there are no others within or near the Minto Flats area which in 1988 are on or eligible for inclusion in the National Register of Historic Places. Also, there are no World Heritage sites in this vicinity, with the nearest one being Wrangell-St. Elias Park, about 200 miles to the southeast.

3.8.2 Ethnographic History

Most of the Minto Flats drainage area was probably used by the Lower Tanana people, many of whom today reside in Minto, Nenana, and Fairbanks. The upper drainages of the Chatanika and the Livengood vicinity were "boundary" areas, and were probably used by Kutchin people who otherwise spent most of their time in the Birch and Beaver Creek drainages, and by the Lower Tanana people who primarily utilized the Minto Flats, Chatanika, Tolovana, and Tanana River valleys.

Prior to the coming of whites and the fur trade, with the emphasis on trapping and the need for fish to support dogteams, the major resource used by both the Kutchin and the Lower Tanana people was probably caribou. Following this was moose, with lesser importance on muskrat, beaver, fish, and waterfowl. Olson (1968) and McKennan (1981) have described the varying importance of caribou for the Lower Tanana, although there is little pre-contact information on these people. There was much more use of fish and the resources of the Minto Flats by the time resource information was recorded (Olson 1981).

After drying and caching fish, the late summer and fall was the time to prepare for caribou hunts in the neighboring uplands. Moose could be taken at any time. The Lower Tanana people or their immediate ancestors undoubtedly hunted caribou with the aid of dogs, or with fences and snares, in the upland country drained by Birch and Beaver Creeks, and the Chatanika, Tolovana, and Tanana Rivers. Small winter "villages" or base camps in the uplands would have been used during most of the fall and winter. During the coldest weather, cached meat and fish would be retrieved from the various storage sites.

In the lean times of late winter and early spring, beaver and muskrat became increasingly important as food sources, necessitating a return to the smaller lakes and ponds in the Minto Flats. The return of waterfowl to the Flats and their subsequent moult made them important prey in the early summer.

During summer, most fishing probably was at camps at the mouths of small clearwater streams. The Chatanika provided habitat for whitefish, grayling, and probably a small salmon run. Before introduction of the fish wheel by whites in 1903 most fish were taken with traps, weirs, or nets in the smaller clearwater drainages.

Since all wildlife resources are subject to fluctuations and changing migration patterns, this sometimes resulted in feast or famine and varying human populations. One would expect to find fish camps or caches of a few family or band members along the major clearwater streams, spring hunting camps at the outlets of small lakes (Olson 1968) or high points in the Flats, and winter encampments or single hunting sites at strategic locations along the drainages and in the adjacent uplands. Any high point could be a reasonable hunting lookout, and the chert outcrops throughout the Livengood area were natural sources for raw material.

These patterns were disrupted after contact with whites by increased dependence on trade goods and fur trapping. This occurred even as early as the establishment of Russian trading posts on the lower Yukon. A prime factor in the seasonal cycle was trading, which usually meant being at Fort

Yukon or Nuklukayet, near Tanana, in early summer. Increased dependence on furbearers meant more extensive traplines and a greater need for fish, preferably salmon, to feed dogteams. With the introduction of the fishwheel, the emphasis shifted to the larger silt-laden rivers, such as the Tanana and the Yukon (which were ready sources of salmon) and the Flats, where furbearers were available. The importance of caribou hunting declined, with a greater emphasis placed on moose as a food resource. By the 1930's the caribou populations had declined and moose had increased, resulting in a greater year-round dependence on the latter resource, as well as fish, muskrat, beaver, and migratory waterfowl (Olson 1968).

By the turn of the century, steamboats were regularly plying both the Tanana and Yukon, causing the emergence of small outlying trading posts and the need for woodcutters along the rivers, a role often filled by Natives. Winter routes also became established, along with roadhouses, to accommodate freighters supplying the goldminers and the mailcarriers, another job often held by Natives and their dogteams.

3.8.3 History

By the time the Russians established the redoubt at Nulato in 1838, trade goods had already made their way upriver from the lower Yukon. The Lower Tanana and Kutchin people traded at both this site and Fort Yukon, which was established by the Hudson's Bay Company in 1847, as well as at the confluence of the Tanana and the Yukon at a site known as Nuklukayet where Tanana is now located.

Despite this, by 1868 Dall reported that no whites had traveled into the area used by the Lower Tanana people. By 1885 when Lt. Henry Allen traveled down the Tanana, he saw very few Natives, probably because they were still following the old subsistence pattern and were not located along the main waterway at that time of the year (Olson 1981).

In 1898, George McManus had scouted a Native trade route which ran between Circle and the Tanana valley (McManus 1899). It appears that this route is now that of the Steese Highway.

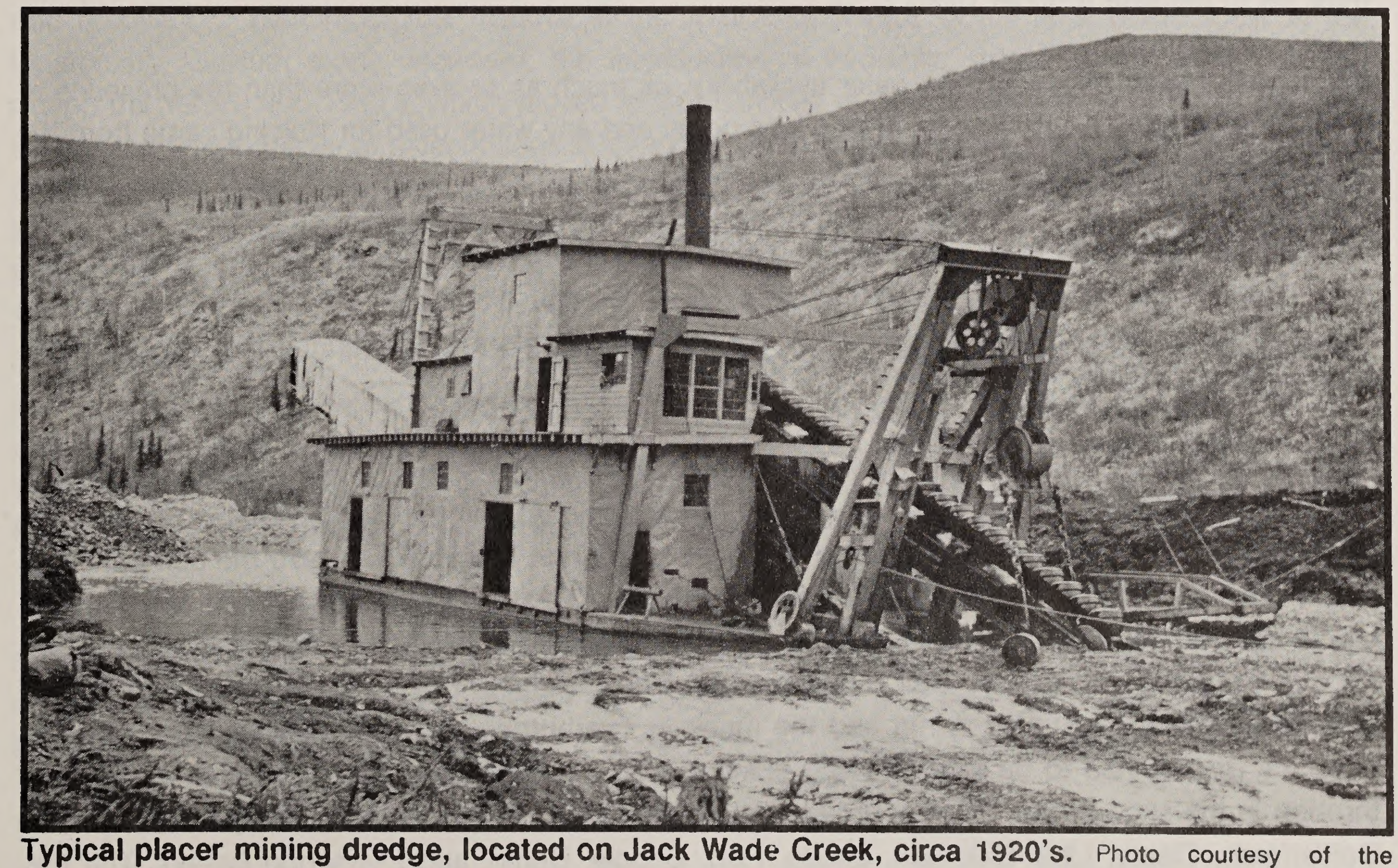
Prospectors continued to explore to the north and west, but it wasn't until Felix Pedro's 1902 "strike" in the Fairbanks district that mining picked up in the drainage. Felix Pedro and Tom Gilmore had been prospecting in the Tanana hills and were about to head back to Circle for more supplies when they saw smoke on the horizon in August 1901. E.T. Barnette, a trader who was headed for Tanacross, found that the attempted steamboat route up the Chena could only go so far and that the location on the banks of the Chena was to be his final destination. The decision of the steamboat captain, Pedro and Gilmore's need of supplies, and their few flakes of gold led to the establishment of a remote trading post that became the community of Fairbanks (Naske and Rowinski 1981).

When Judge James Wickersham took the blank recorder's books to the new mining camp of Fairbanks from Circle in April 1903, he followed the winter sled trail by dogteam. This route was already in use by prospectors and freighters on their way to the Tanana rush resulting from Pedro's strike in 1902 (Wickersham 1938).

In 1902, the Washington-Alaska Military Communication and Telegraph System line down the Tanana Valley was constructed and a station at Tolovana, at the Native fishcamp at the confluence of the Tolovana and Tanana Rivers (Bowers 1986) was completed, as well as one near the site of Manley Hot Springs.

From 1899 through the 1950's the Fairbanks and Chatanika areas saw many mining communities come and go. Some of the larger ones such as Tofty (pop. 300), Livengood (pop. 150), Cleary (pop. 1,000+), Dome (pop. 300), Fox (pop. 500), and Olnes (pop. 250) had hotels, saloons, laundries, and other facilities during their peak occupations. However, "camps" as small as Gilmore, Eldorado, Vault, Woodchopper, Olive Creek, Mike Hess, and Stampede had only post offices for short periods to mark their place in history (Heiner 1977). Some communities such as Chatanika, Ester, Fox, Livengood, and Manley have persisted to the present due to a roadhouse, saloon, or post office.

Only Fairbanks and Nenana have remained as full-scale towns. Tortella Hill, the bluff near Nenana was a traditional "gathering place" for Lower Tanana people of the area (Olson 1968) and a few cabins existed at the site in 1902 (Brooks 1953), but the community grew when St. Marks Indian Mission was founded in 1916. The population rose to 1,000 when it became a supply base for con-



Typical placer mining dredge, located on Jack Wade Creek, circa 1920's. Photo courtesy of the Anchorage Museum of History and Art.

struction of the Alaska Railroad, which was completed as far as Nenana in 1923. By 1925 the railroad was completed to Fairbanks. Access for the river barges shipping up the Yukon, the railroad, and Nenana's proximity to Denali National Park have kept the community active.

Although early prospectors used goldpans and rocker boxes or cradles, most early mining in Alaska involved sinking holes to bedrock, where the heavy gold had settled out of the alluvial material. The ground was thawed by wood fires, hot rocks, hot water, or steam points. The dirt was excavated with a pick, shoveled into a bucket, and hoisted to the surface with hand windlasses (Prindle 1906). Depending on the availability of water, the dump would then be sluiced and the gold collected from the riffles of the sluice boxes.

Drift mining where the deeper gravels were mined involved sinking a shaft 20 to 120 feet, timbering the shaft and the horizontal drifts running from the shafts along the gold-bearing gravel, then hoisting the gravel to the surface for sluicing (Prindle 1906). This technique was the most common and was usually undertaken during the winter when the solidly frozen ground provided additional support, important since wood was frequently scarce. The hoisted gold-bearing gravel would then be sluiced during the summer when melted streams provided the needed water. Much of the early mining in the Fairbanks District used this technique.

Open-cut mining was limited to the few locations where the gold- bearing material was shallow enough, mainly in the headwaters of the creeks. This technique was accomplished by removing the overburden and then constructing bedrock drains into which sluice boxes were set. The boxes were either moved up the valley as material was sluiced in, or the gravel was hoisted into boxes which were set to the side (Prindle 1906).

Mining was highly dependent on water availability, as much as or even more than the presence of gold. Prior to 1905, no extensive ditching was done, and any water used for sluicing came from the creek being mined (Prindle 1906).

The first dredge in the Fairbanks District was brought to Fairbanks Creek from the Stewart River near Dawson by the British-owned Fairbanks Gold Dredge Company in 1911. Another dredge replaced it in 1918 and was purchased by the Fairbanks Exploration Company (F.E. Co.) in 1931 (Matheson and Haldeman 1981).

Since 1920, the F.E. Co., a wholly owned subsidiary of the United States Smelting Refining and Mining Company (USSR&M), had been buying out smaller operators in the Fairbanks area. In 1924 the company began an intensive prospecting and drilling program. Beginning in 1925 the company was the largest contributor to the Interior Alaska economy. By 1930 the company had five dredges operating, and four others were operated by other companies (Matheson and Haldeman 1981). Prior to dredging, the ground was drilled to determine the depth of overburden, gravel, and gold prospects; drains had to be put in and the muck or overburden had to be hydraulically stripped. Then the gravels had to be thawed using points driven the previous winter that water was flushed through in the spring. After this the dredge could be moved in for operation. Dredges operated on Goldstream, Cleary, Little Eldorado, Sheep, Fish, Cripple, Dome, and Livengood Creeks. The F.E.

Company's dredges operated in the Fairbanks area from 1929 until 1963 (Boswell 1979). In 1955, Dredge #6 at Livengood was dismantled, hauled to Fairbanks, and barged to the Hogatza River in the Koyukuk drainage where it still operates.

The Davidson Ditch was constructed from 1925 to 1928 to provide water from the Chatanika for the F.E. Company's goldfields near Fairbanks. Beginning at a diversion dam on the Chatanika, three-quarters of a mile below the confluence of Faith and McManus Creeks, water was diverted through an open ditch down the Chatanika valley above the Steese Highway, through inverted siphons across the side drainages and the Chatanika River,by tunnel through the hillside between Vault Creek and Fox Gulch, and then to the Engineer Creek operations (Boswell 1979). A remaining stretch of the Davidson Ditch from Miles 32 to 69 undesignated LIV 073 and CIR 010, with its siphons and flumes, was determined eligible for the National Register of Historic Places.

By the late 1920's bulldozers were introduced. World War II closed down all mining in the district as non-essential to the war effort, and the government confiscated the heavy equipment. A few bulldozers were used after the war, but by the 1960's mining was virtually non-existent due to the low price of gold. However, the rapid rise in gold prices in the 1970's caused renewed activity in the Interior. Such equipment as bulldozers and front- end loaders came into use to strip the overburden and push gravel into sluice boxes.

3.8.4 Paleontology

By the turn of the century early mining and prospecting probably had some impact on the discovery and recovery of paleontological material in the smaller drainages of the area where most of the Quaternary alluvium exists. However, the introduction of hydraulic stripping and dredge mining during the 1920's and 1930's, which moved large quantities of frozen overburden or muck, resulted in significant discoveries of paleontological specimens and artifacts throughout the Fairbanks district (Rainey 1939). Geist and others collected numerous paleontological specimens such as mammoth, horse, bison, mastodon, musk ox, and elk from creeks mined in the Circle, Livengood and Fairbanks districts (Lindsey 1986).

There is a possibility for further discoveries during mining operations, although past techniques such as hydraulic mining were not as destructive to such fragile specimens. Since the inception of a BLM paleontology program in 1983, such fossil remains have been recorded from mining operations on Willow, Olive, Lillian, Livengood, and Amy Creek in the Livengood area and Woodchopper, Minook, Rhode Island, and Omega Creek in the Tofty/Eureka area (BLM fieldnotes and summaries 1983, 1985).

Some specimens discovered were "fresh frozen" rather than fossilized. Even recently, such intact examples as "Blue Babe" a 36,000-year-old Ice Age bison found in a hydraulic mining operation near Fairbanks, are indicative of the importance of these frozen deposits of overburden.

3.8.5 Discussion

There is a curious relationship between mining and cultural resources. The existing knowledge of prehistory in Interior Alaska is limited. The remoteness of the country and scarcity of sites along with dense vegetation and permafrost make cultural resources generally difficult to find. On one hand, mining has promoted understanding of the past because of artifacts collected from sluice boxes, fossils exposed during hydraulic stripping, and site locations identified during exploration or prospecting. On the other hand, mining operations often destroy cultural material. Current mining practices are much more destructive than early day techniques, and ironically, today's mining often destroys evidence of earlier mining which may, in itself, be of historic interest.

The regulations concerning cultural resources and mining are contradictory. The regulations in 36 CFR 800 require that BLM identify all possibly eligible cultural resources to the National Register of Historic Places, and allow for comment by the State Historic Preservation Officer (SHPO) within 15 days and the Advisory Council on Historic Preservation (ACHP) within 30 days prior to allowing activity that may impact such sites. In contrast, 43 CFR 3809.1-6(5)(c) states that BLM or the operator shall have 30 days to complete an appropriate cultural resources inventory prior to approval of a Plan of Operation. Should cultural resources be discovered during operation under a Plan, the operator must leave the discovery intact and notify the Authorized Officer, who has ten days to remove or protect the resource before allowing the operator to proceed [43 CFR 3809.2-2(e)]. Cultural resources are not covered under Notices other than under "undue or unnecessary degradation.

Most mining today takes place on previously disturbed ground. This trend is likely to continue for some time as gold recovery techniques improve. Most of the damage to cultural and paleontological resources has probably already taken place in the drainages currently available for mining.

It is physically and economically impossible to locate and recover all cultural and paleontological resources prior to surface disturbing activity. However, if these resources were left permanently protected in the ground, we would have virtually no knowledge of prehistory in Alaska. Since locating these resources in river valleys is rare, frequent monitoring of mining operations and good working relationships with the operators have proven more effective to identify and recover inadvertently discovered cultural and paleontological materials. Education, crediting the discoverer, and making research or analysis results available to the public help protect and mitigate any adverse impacts to such resources.

3.9 Subsistence

3.9.1 Introduction

Minto Flats has been used for subsistence purposes for generations according to the inhabitants of the village of Minto (Wiggins 1978, Fejes 1981, Shepherd et al 1985, Shepherd 1987). The area is composed of many lakes, ponds, and streams which drain principally from the Chatanika and

Tolovana Rivers, and Goldstream Creek watersheds. Eventually, the Flats area is drained into the Tanana River through sloughs and other outlets. An abundance of animal, bird, fish, and plant life inhabits the Flats area, providing an excellent subsistence base for the largely Athabaskan Native inhabitants.

Minto village, located on the Flats overlooking the Tolovana River, had an estimated population of 179 in 1984, 99% of which were Athabaskan (ADF&G 1987c). In 1983, 85% of the households in Minto harvested waterfowl, 78% fished for salmon, generally from the Tanana River, 76% hunted moose, and 46% trapped. Per capita harvest levels are estimated at 933 pounds (ADF&G 1986a). Taxable income was reported for 1984 at $9.252 (ADF&G 1987c), far below the State of Alaska average of $21,127 (ADF&G 1986a), and indicating the importance of subsistence harvest for Minto residents.

As gold was discovered on tributaries of the Tolovana River, the area opened rapidly to prospectors, settlers, merchants, steamboat travel, missionaries, and government agents. Consequently, life began to change for the people of Minto Flats. Cordwood for steamboats and fish for dog teams could be sold for cash. Trading could be done at the new posts at Nenana and at the mouth of the Tolovana River, although the more traditional journeys along the Yukon River continued. Subsistence activities, however, did not change much in the earlier part of the 20th century, although a strict seasonal round became more permanently based from Old Minto, located about 20 air miles south of present Minto. By 1915, Old Minto on the Tanana River was occupied as a permanent settlement when some Minto Band members built some log cabins there. Others lived there in tents seasonally, but steamboat traffic on the Tanana River meant not only that goods were available, but so were opportunities to earn cash by cutting wood for the boats (Andrews 1979). Eventually, an Episcopal mission church and school were built in Old Minto (Wright 1985), and the community became a consolidation of families from other major settlements such as Nenana, Chena, and Toklat (Olson 1968, 1981; Tanana Chiefs Conference, Inc. 1983; Andrews 1977).

The present village of Minto, with an all-weather road to Fairbanks, has been permanently occupied since 1971 when resettlement from Old Minto occurred, largely because of flooding along the Tanana River. The site of the new village is also a traditional base camp, similar to Cache, with at least six permanent cabins dating prior to 1971. A cemetery also existed at new Minto prior to the establishment of the new village (Andrews 1979).

Today, residents of Minto are the main subsistence users of the Minto Flats area. At times, other nearby villages including Rampart, Tanana, Nenana, and Manley Hot Springs also benefit variously from subsistence activities on the Minto Flats. For example, Peter John of Minto (1986) reported many trips to these villages for baptism, confirmation, funeral potlatches, and other social reasons besides trading. Fish or game from Minto Flats often would be brought on such visits for use in traditional patterns of exchange and distribution.

3.9.2 Subsistence Uses

The traditional subsistence area of the Minto villagers extends from Livengood and Sawtooth Mountain on the north to the mouth of the Kantishna River on the south, Murphy Dome and the middle Chatanika River on the east to Dugan Hills in the west (Shepherd et al. 1985). Virtually all fish and wildlife species present in the region are used for subsistence purposes. Harvest techniques include hunting, fishing, and trapping, with use of boats being important for access to traditional riverine or lake subsistence use areas. In addition to Minto residents, Minto Flats receives some direct usage for subsistence purposes by people now living in Nenana (Shinkwin and Case 1984). Traditionally, others also used the Flats, including residents of Tanana and Stevens Village.

Many villages depend on fish for subsistence use. Courtesy of Bureau of Land Management.

In general, traditional subsistence use of the area meant a family or group of families utilizing and exploiting resources as hunter-gatherers. Settlements were maintained only so long as resources in the area were being used; that is, a seasonal round of subsistence activities was followed (Olson 1981). At freezeup, people were in localities where they could ice fish, and where moose and bear could be hunted. Also, at this time, hunting hares and molting birds on islands was common. During the winter trapping season, people stayed in temporary camps along traplines usually from about November through February, during which time hunting moose and snaring hares was also done (Shepherd et al. 1985, Olson 1981). By March, people spread through the Flats for hunting and trapping muskrat and using fish traps under the ice to catch blackfish. Traditionally, people from Tanana and Stevens Village came into Minto Flats at this time to hunt muskrat. After breakup, beaver and waterfowl were harvested; as many as 30 ducks per day could be caught and dried for future use

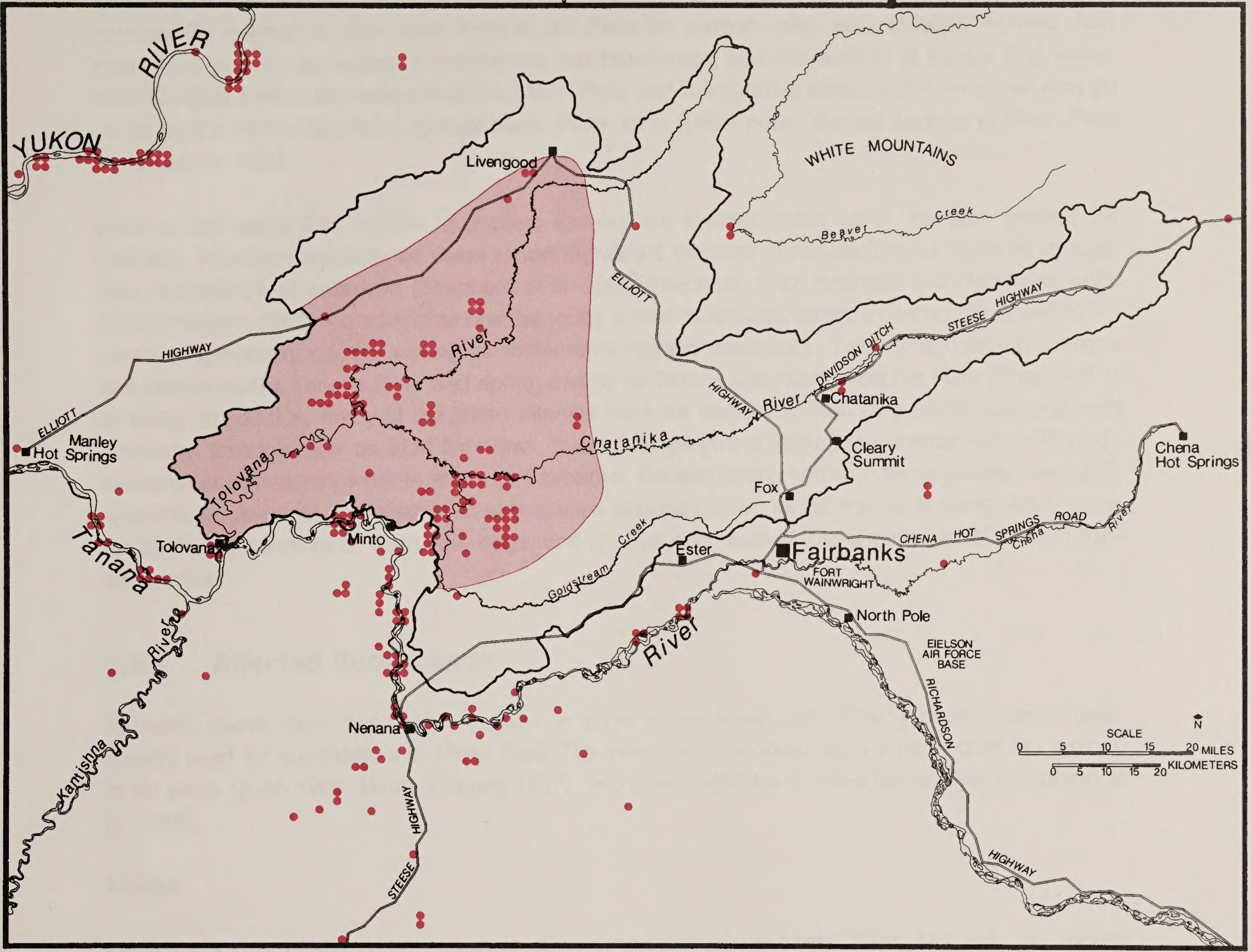
Minto Flats Placer Mining

DRAFT

Cumulative Environmental Impact Statement

Subsistence 1 of 3

Traditional Subsistence Use areas within the Minto Flats Drainage, and Native Allotments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WHITE MOUNTAINS
Beaver Creek
ELLIOTT
HIGHWAY
STEESE HIGHWAY
DAVIDSON DITCH
River
Chatanika
Chatanika
River
Manley Hot Springs
Tolovana
Tanana
Tolovana
Minto
Cleary Summit
Fox
Chena Hot Springs
CHENA HOT SPRINGS ROAD
Chena River
Goldstream Creek
Ester
Fairbanks
FORT WAINWRIGHT
North Pole
EIELSON AIR FORCE BASE
River
RICHARDSON HIGHWAY
Nenana
Kantishna River
STEESE HIGHWAY
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS
N

Legend

▨ Minto Village traditional subsistence use area*

●● Sites of Native Allotments. Each symbol may represent more than one allotment.

*Derived from Shepherd et al. (1985)

LOCATION MAP

MINTO FLATS WATERSHED
YUKON
RIVER
FAIRBANKS
ANCHORAGE

Data came from the Alaska Department of Fish & Game, Division of Subsistence, which qualifies such maps by stating: 1. subsistence use areas depicted are based on information obtained from a sample of community households; 2. subsistence patterns of household resource use may change from year to year while information is collected for specific periods; 3. therefore all maps can be considered potentially only a partial representation of areas important to local village residents.

Note: This map includes data from the following communities only: Northway, Chicken, and Eagle.

(John 1986, Minto Villagers 1987). After ice cleared from the creeks, families grouped together for whitefish harvest and waterfowl hunting. In the summer, people went to the Tanana River to fish for salmon. By August, families were back in the Flats for salmon, pike, and whitefish harvest. Also done then was the gathering of cranberries and blueberries, and the hunting of moose and waterfowl. Caribou historically were present in Minto Flats and surrounding areas, and men would also go as far as the White Mountains to hunt them. Peter John (1986) noted the last caribou in Minto Flats were seen in 1928.

Most of the same fish, wildlife, and plant species are present today as in the past (except for caribou). However, subsistence users report significant declines in populations of muskrat, moose, pike, whitefish, and waterfowl (Shepherd et al. 1985, Shepherd 1987, Andrews and Napoleon 1985, Minto Villagers 1987). An additional change today is that most subsistence activities are based in villages or temporary camps instead of settlements moving seasonally. Two exceptions are salmon fish camps on the Tanana River and spring camps for fishing and hunting on the Flats (Shepherd et al 1985). In addition, many of the Minto villagers work for wages, or otherwise participate in a cash economy, through work on BLM fire crews, through employment related to construction, or through seasonal or permanent work in Minto or Fairbanks. Consequently, some of these people have only sporadic or seasonal participation in subsistence activities, such as fall moose hunting. Also, some residents sell handicrafts, sleds and dogs, and at least one resident has a commercial salmon fishing license.

3.9.3 Affected Subsistence

As noted above, there has been a decline, in some cases significant, of many of the species traditionally used for subsistence in Minto Flats. The villagers have noted such a trend over the past 70 to 80 years (John 1986, Minto Villagers 1987), and others also have noted the decline (Shepherd et al. 1985).

Moose

Moose are one of the most important subsistence animals in Minto Flats. Not only do moose provide customary meat for daily consumption, but they also provide meat and other substances for potlatches (Andrews and Napoleon 1985, Fejes 1981, Wiggins 1979). Normally, the brisket, head, ribs, backbone, stomach, and leg marrow are saved for use during funeral or memorial potlatches when the entire community and guests are present. Also, moose meat from a successful hunt often is distributed throughout the community to related families of the hunters, unsuccessful hunters, elders, and persons needing meat. Thus, moose fills social and religious as well as subsistence needs.

The current moose population of Minto Flats is estimated at one moose per square mile (Shepherd 1987); however, at the peak population in the mid-1960's there may have been five times as many (ADF&G 1983). The decline has meant that ADF&G, in 1979, made Minto Flats into a special management area, with moose hunting by permit to subsistence hunters only (Andrews and Napoleon 1985, ADF&G 1987c). This remains the case in 1988. Open season within the Minto

Management Area was September 1 to September 20, 1987, and January 10 to February 28, 1988. A total harvest of 15 bulls was allowed, with the season closed if and when that figure was reached. Overall, while the harvest in the recent past has averaged eight moose per year (ADF&G 1987c), a number of the villagers do not consider this sufficient for their subsistence needs (Minto Villagers 1987). For example, in the 1984-85 season, 29 permits were issued for the fall season in Minto, and six moose were harvested; 30 permits were issued for the winter season, and one moose was harvested (Andrews and Napoleon 1985).

Moose population declines can be attributed to heavy winter losses in the late 1960's and early 1970's (Shepherd 1987, Andrews and Napoleon 1985), and probably not to possible effects from gold mining. Hunting regulations were not changed until the 1975-76 season, and overhunting prior to then may have affected an already depleted population (Shepherd et al. 1985, Shepherd 1987). Additionally, wolf control was halted in the late 1970's with a resultant increase in wolf populations. Perceptions by the villagers, if not reality, indicate that the high wolf population contributes to the low moose population (Minto Villagers 1987, Shepherd 1987). Minto villagers (1987) cited an example of the synergistic effect of generally lower water levels in 1987 in the Minto Flats area combined with possibly increased sedimentation and more wolves. They spoke of wolves being able to gain dry land access to an area previously protected by water and traditionally used by moose to raise young. The result was that wolves preyed upon the moose calves and caused a further decline of the moose population in the area.

Black Bear

Black bear hunting in Minto Flats occurs most often during the spring and summer. In the fall, more bears are found in the upland areas that surround the Flats. Records from ADF&G (1985) indicate an annual average of ten bears harvested from the Flats, plus 20-30 from along the road system. These figures include both subsistence and recreational hunters. Traditionally, subsistence hunting of bears also occurred during the winter (John 1986) by stabbing or shooting bears in their dens. Today, however, bears actually contribute very little to subsistence levels (Shinkwin and Case 1984).

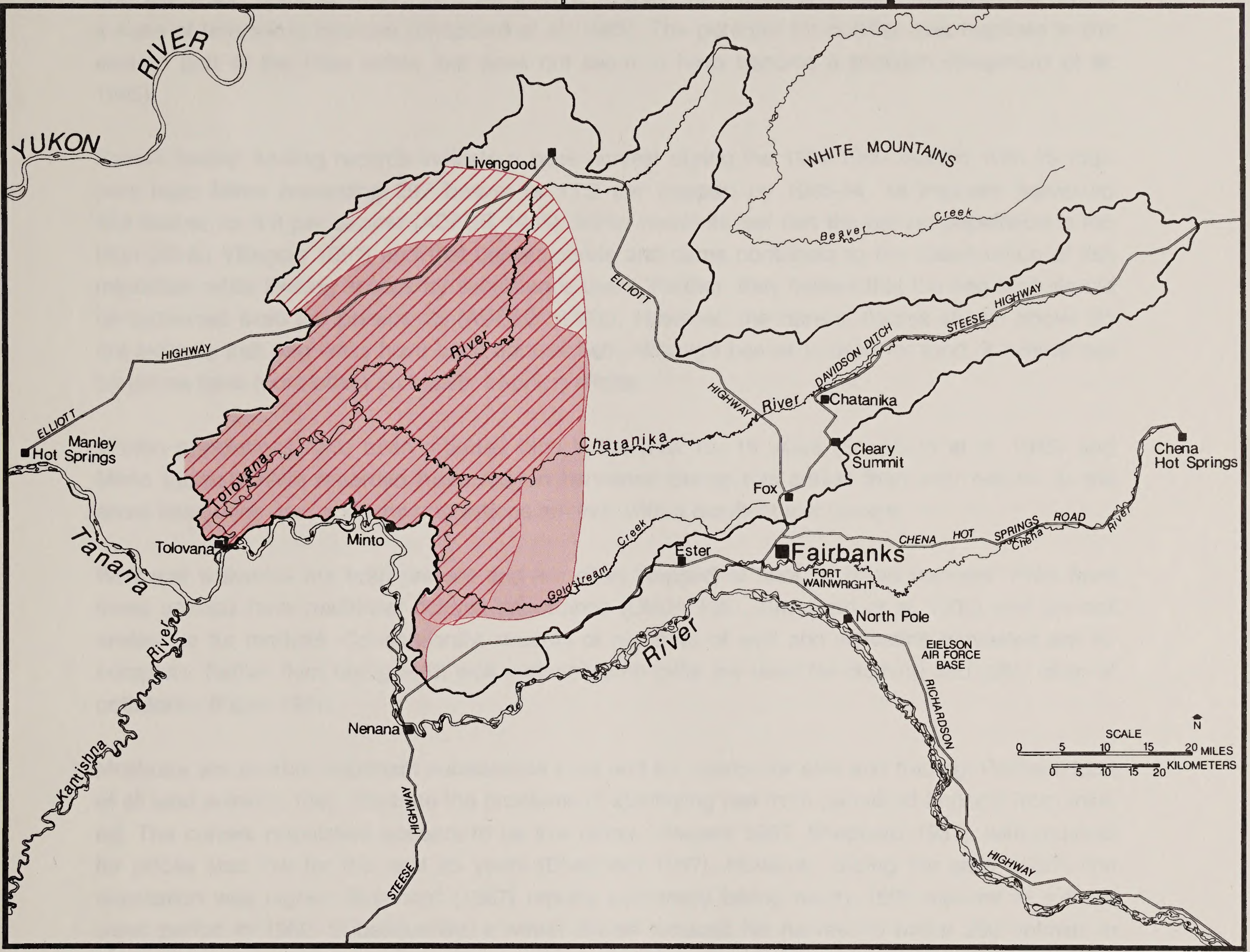
The population of black bears in Minto Flats is unknown (Shepherd 1987), but it seems stable and able to maintain the current harvest levels. There is some feeling among villagers that a large bear population has some effect on the moose population (Minto Villagers 1987). Bears will kill moose, especially calves. Shepherd et al. (1985) indicates that in wet years both moose and bears occupy the same habitats, thus increasing bear predation on moose and perhaps stressing an already depressed moose population.

Furbearers

Trapping of furbearers by subsistence users ranges in importance depending upon fur prices; however, furbearers, especially beaver and muskrat, may also be used for human or dog consumption. Urban trappers, mostly recreational, also trap on Minto Flats, usually on the east side. When the village was moved to its present location in 1971, urban trappers felt that an unused area existed on the eastern side of the Flats (Shepherd et al. 1985), when in fact Minto villagers were still

Subsistence 2of3

Subsistence Uses within the Minto Flats Drainage:
Moose Hunting
Fur Trapping

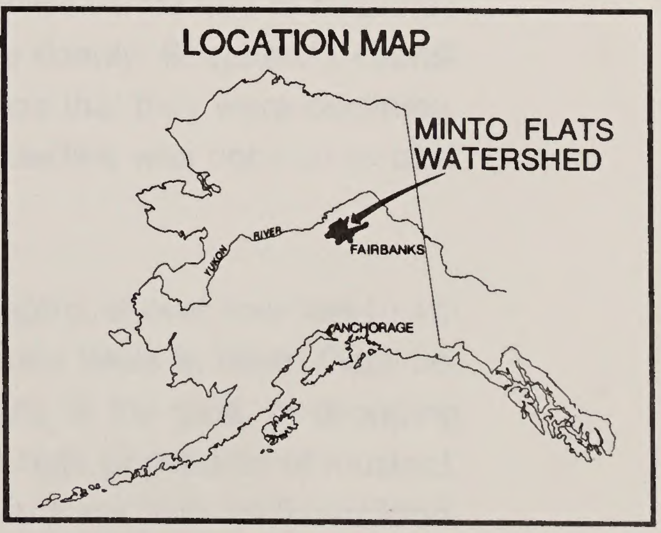

YUKON
RIVER
WHITE MOUNTAINS
Beaver Creek
Livengood
ELLIOTT HIGHWAY
HIGHWAY
ELLIOTT
Manley Hot Springs
River
Tolovana
Chatanika
River
DAVIDSON DITCH
STEESE HIGHWAY
Chatanika
Cleary Summit
Fox
Chena Hot Springs
CHENA HOT SPRINGS ROAD
Chena River
Tanana
Tolovana
Minto
Goldstream Creek
Ester
Fairbanks
FORT WAINWRIGHT
North Pole
EIELSON AIR FORCE BASE
River
Nenana
Kantishna River
STEESE HIGHWAY
RICHARDSON HIGHWAY
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS
N

Legend

- 🟥 Moose Hunting area*
- ▨ Fur Trapping area**

*Andrews and Napoleon (1985)

**Andrews and Napoleon (1985) and Shephard et al. (1985)


LOCATION MAP
MINTO FLATS WATERSHED
YUKON RIVER
FAIRBANKS
ANCHORAGE

Data came from the Alaska Department of Fish & Game, Division of Subsistence, which qualifies such maps by stating: 1. subsistence use areas depicted are based on information obtained from a sample of community households; 2. subsistence patterns of household resource use may change from year to year while information is collected for specific periods; 3. therefore all maps can be considered potentially only a partial representation of areas important to local village residents.

Note: This map includes data from the following communities only: Northway, Chicken, and Eagle.

using traplines there. Depending upon fur prices and furbearer populations, traplines may be utilized only every two years, or even less often; thus, what may seem to be an unused area may be only in a state of temporary non-use (Shepherd et al. 1985). The potential for conflict over traplines in the eastern part of the Flats exists, but does not seem to have become a problem (Shepherd et al. 1985).

Recent beaver sealing records indicate a peak harvest during the 1979-1980 season, with 25 trappers from Minto harvesting 297 beaver or 11.9 per trapper; by 1983-84, 16 trappers harvested 109 beaver, or 6.8 per trapper (ADF&G 1985). Minto residents feel that the beaver population is too high (Minto Villagers 1987) and that beaver ponds and dams contribute to the deterioration of fish migration, while limiting access by subsistence users. Further, they believe that the bag limit should be increased from the present 25 (ADF&G 1987c). However, the harvest figures shown above do not indicate that bag limits have been approached. Although beaver is used for food, it seems that fur prices have more effect on beaver trapping efforts.

Marten populations have been reported high in the past 10- 15 years (Shepherd et al. 1985) and Minto trappers have recorded more marten harvested during this period than ever before. At the same time, mink, fox, and lynx populations are low, with a resultant low harvest.

Wolf and wolverine are both present and are either trapped or shot by Minto trappers. Pelts from these animals have traditional cultural importance (Olson 1981, Shepherd et al. 1985) and are not sealed for fur markets. Consequently, records of numbers of wolf and wolverine harvested are incomplete. Rather than being sold, wolf and wolverine pelts are used for clothing and gifts, often at potlatches (Fejes 1981).

Muskrats are another important subsistence food and fur source for sale and trading. Perhaps best of all land animals, they illustrate the problems of identifying real from perceived impacts from mining. The current population appears to be low (Minto Villagers 1987, Shepherd 1987), with muskrat fur prices also low for the past 25 years (Shepherd 1987). However, during the early 1950's the population was higher. Shepherd (1987) reports personally taking nearly 1500 muskrat in a three week period in 1952. Subsequently, a winter die-off reduced his harvest to under 200 animals in 1954, with reduced numbers thereafter into the mid-1960's. In general, while winter kills of muskrats do occur periodically when there is little snow cover and the lakes freeze deeply, Shepherd's overall assessment of muskrat population during the 1950's and early 1960's was that they were declining, but that no noticeable habitat degradation had occurred and that their decline was not due to past or present mining (Shepherd 1987).

Changes in water depths in Minto Flats affect muskrats, which require depths of over four feet to access winter foods and to prevent freezing out (Shepherd 1987). As certain lakes in Minto Flats became shallower due to drier climate, increased sedimentation particularly in the past, or dropping underground water tables, those areas have not been able to maintain a high population of muskrat. Yet Shepherd (1987) concludes that such effects have been limited in areas with sedimentation, where it has occurred, related less to past mining than to other causes. He reports: "Deterioration of habitat attributable to deposition of hydraulic mining silt is limited to a portion of the Goldstream area and perhaps some in the Tolovana Lake area. ...[which] represents only a fraction of the unsilted muskrat habitat available on Minto Flats.... [Otherwise] a majority of the ponds and lakes on Minto Flats are situated on slightly higher ground and are not normally subject to infilling by suspended solids.... Most infilling of these bodies of water occurs from vegetative succession, decay, and natural soil erosion" (Shepherd 1987).

Waterfowl

After breakup, the lakes, ponds, and streams of Minto Flats support an abundance of waterfowl. Both subsistence and recreation hunters intensively hunt ducks and geese in the area. Area lakes in particular are important habitat for nesting and breeding populations of ducks, geese, and swans. A number of studies of waterfowl in Minto Flats exist (Hooper 1952; Rowinski 1958; Shepherd 1961, 1962, 1963, 1966) that suggest productivity varies according to flooding and the lateness of spring. Conant (1985) indicates populations of ducks range from 53-90 per square mile. Shepherd (1982) also states that habitat loss in wintering areas affects populations of waterfowl, rather than habitat loss in Minto Flats.

However, local subsistence users Peter John (1986) and other Minto villagers (1987) have stated that in the past few years their harvest of ducks has gone down drastically. One women reported that in 1987 she had gotten only three ducks where in past years she had harvested over 30 (Minto Villagers 1987). In the past, ducks were dried for later use (Olson 1981). Today, they are more often frozen.

There is sport hunting of waterfowl on Minto Flats. Shepherd (et al. 1985, 1987) states that populations and area available for hunting should accommodate current levels of activity both by sports and subsistence hunters. Additional problems, such as aircraft disturbance in some feeding and resting areas and wasting of meat by sport hunters, are manageable (Shepherd et al. 1985).

Fish

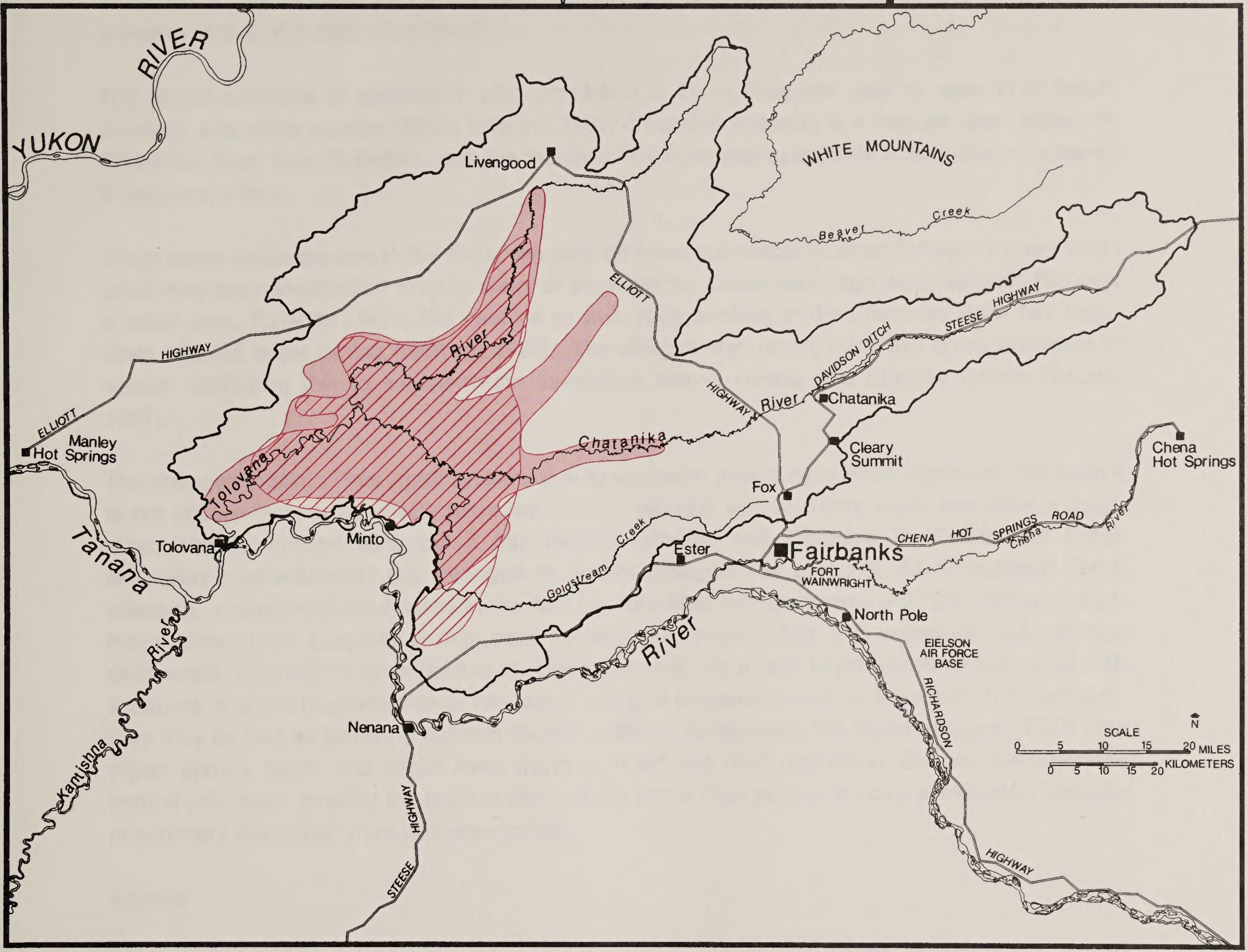
Humpback whitefish, pike, sheefish, and broad whitefish are the most important species of fish used for subsistence purposes, with least cisco, burbot, and suckers occasionally harvested. Three salmon species are present in Minto Flats waters, but the Tanana River salmon fishery is more important to Minto subsistence users (Olson 1981, Shepherd 1987). Currently, low populations of pike, least cisco, and humpback whitefish may affect subsistence users (Shepherd et al. 1985).

Pike is used for dog food during the summer and human food at other times. The Tolovana and Chatanika Rivers are primary pike fishing areas, as are the larger lakes. Set and dip nets are used for pike and whitefish in the spring and summer. In winter, a hook and jig is used for ice fishing for pike, or a short gill net is set under the ice (Silas 1987). In 1984, 3,000 pike were caught by subsistence users, providing 74 pounds per capita, or 7.5% of all subsistence food in Minto (Silas 1987).

The pike fishery in Minto Flats also provides excellent sport fishing, producing trophy-sized fish. The road system, including the new road from Murphy Dome to the Chatanika River completed in 1982, and extensive use of snowmobiles in winter, have caused sport fishing to increase. However, the

Subsistence 3of3

Subsistence Uses within Minto Flats Drainage: Waterfowl Hunting Fishing


YUKON
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Beaver Creek
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HIGHWAY
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STEESE HIGHWAY
DAVIDSON DITCH
Chatanika
River
ELLIOTT
HIGHWAY
Manley Hot Springs
Chatanika
Cleary Summit
Chena Hot Springs
Tolovana
Fox
Tanana
Tolovana
Minto
Goldstream Creek
Ester
Fairbanks
FORT WAINWRIGHT
CHENA HOT SPRINGS ROAD
Chena River
North Pole
River
EIELSON AIR FORCE BASE
River
RICHARDSON
Nenana
Kantishna
HIGHWAY
STEESE
HIGHWAY
SCALE
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS
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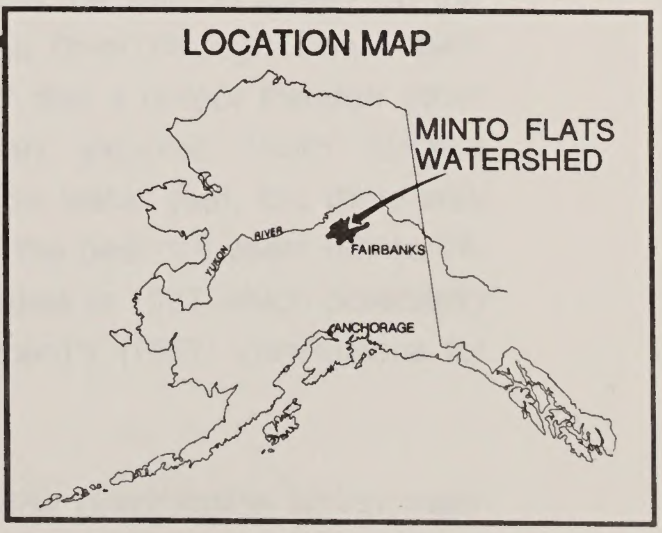
Legend

▨ Waterfowl hunting area

🟥 Fishing area (including some salmon)*

*Andrews (1986) and Shepherd et al. (1985)


LOCATION MAP
MINTO FLATS WATERSHED
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Data came from the Alaska Department of Fish & Game, Division of Subsistence, which qualifies such maps by stating: 1. subsistence use areas depicted are based on information obtained from a sample of community households; 2. subsistence patterns of household resource use may change from year to year while information is collected for specific periods; 3. therefore all maps can be considered potentially only a partial representation of areas important to local village residents.

Note: This map includes data from the following communities only: Northway, Chicken, and Eagle.

pike population showed a 50% reduction from 1977 to 1982 (Silas 1987). In 1961, the Chatanika River and, in 1981, Goldstream Creek were closed to subsistence pike fishing, but the villagers were unaware of this until 1986 (Silas 1987).

The above examples of declines in pike population in Minto Flats can also be seen in whitefish, sheefish, and other species (Minto Villagers 1987). Whitefish spearing is a popular sport along the Chatanika River near Fairbanks, and the increase in this activity apparently affects the subsistence fishery in the flats.

When water levels are low in the Flats, fish may be more vulnerable to sport fishing (Cheney 1971) since they are concentrated in deep water or confluences. Conversely, high water spreads fish over a wider area. Turbidity affects fish catches as well. High turbidity in the Chatanika River has negatively affected spear fishing (Hallberg 1983). The villagers also report fewer fish going upstream to spawn, attributing this to sedimentation, numerous beaver ponds, and turbidity (Minto Villagers 1987).

The changes in Minto Flats water systems due to upstream mining have been significant, although it is not always clear what effects there may be on fish and wildlife. Minto Lake was once a deep, clear, and forest-lined lake, but it has become shallow and eutrophic as Goldstream Creek deposited mud and eventually changed its course (Shepherd et al. 1985). As Goldstream Creek changed, a number of small lakes in the flats became filled with sediments (ADF&G 1987a). A shallower Minto Lake supports a rich biota beneficial to rearing fish and waterfowl, but perhaps detrimental to muskrats (Shepherd et al. 1985). However, as a lake becomes completely filled with sediment, it is lost to production of fish, waterfowl, and furbearers; also, as lakes become shallower, they may be lost as wintering habitats (ADF&G 1987a). Additionally, the Minto Villagers (1987) also report spruce, birch, and willow trees dying from silt and mud deposition. Overall, the otherwise natural processes causing the gradual filling of the Minto Flats appear to have accelerated because of sediment deposition from upstream mines.

Access

One additional factor in subsistence is access, such as river access to the salmon fishery on the Tanana River. Normal access from the village is down the Tolovana River through Swan Neck Slough. However, this slough was so low and sediment-filled in 1987 that a detour through other streams was necessary, causing inconveniences of increased time and expense (Minto Villagers 1987). Slough access may have been closed because 1987 was a low water year, but there was some feeling among the villagers that it had been filling up more over the past few years (Minto Villagers 1987). People in Minto also noted low water levels in certain lakes in 1987 which potentially limited their customary access to subsistence areas. Overall, Shepherd's (1987) conclusions for what actually has occurred recently are as follows:

> " ...weather records since the early 1960's suggest above average precipitation which maintained higher than average water levels at Minto (Shepherd et al. 1985). The summer of 1987 was much drier than average, apparently hindering boat travel in some areas and may have prompted concern over water levels. Perhaps the higher than normal precipitation of the last

> 30 years has masked a change in ground water levels, especially within those systems subject to annual flooding. It would be physically impossible for most of the upland lakes and ponds, especially those not connected by channels to watershed streams, to have been subjected to deposition of enough mining silts that they became nearly dry.
>
> "These trends have been observed at Minchumina Lake and on the Mud River Flats in the Kantishna River watershed. The suggestion that recent (past 15 years) placer deposits on Minto Flats are responsible for this drying trend seems remote since the amount of silt required to accomplish this condition would far exceed that removed during the period of hydraulic mining. However, silt deposited by the Tanana River has certainly changed much of the habitat between Swanneck Slough and the lower Tolovana River."

Plants

Plants commonly found on Minto Flats and used for subsistence purposes include blueberries, cranberries, and raspberries. Also, wood from local trees is used for heating, construction of houses, sleds,and other items (Hosley 1981, Olson 1981). There is no evidence or perception that plant resources are endangered or lessened.

Native Allotments

Native Allotments have been provided for until 1971 by legislation dating back to 1906. Most are in the southern part of Minto Flats, although they are present throughout the area. Allotments are often located in areas of traditional subsistence use and sustain a variety of activities, including fishing, hunting, or maintenance of traplines. Many are accessed by water.

3.9.4 Conclusions

The above discussion of subsistence uses and concerns shows that the Minto Flats area has lower subsistence resource availabilities in some instances for traditional subsistence users. Yet the causes are complex and include both natural and human factors. Hard winters, lower water levels, possible geologic uplift, turbidity, natural and mining-caused sedimentation, and increased sport hunting and fishing plus more wolves may have all had their effects. Further, the all-weather Elliott Highway connecting Minto village to Fairbanks, and the opening of other access into the area (the 1982 Murphy Dome to Chatanika River road) have facilitated resource harvest possibilities by non-local residents. Additionally, game management practices and regulations and hard winters have had effects on some animal populations. In all, moose, muskrat, mink, pike, whitefish, and sheefish populations have declined in certain areas, at least over the past 15-20 years. The decline in moose and pike populations has brought some response by the Alaska Department of Fish and Game to limit harvest to subsistence users, although perhaps belatedly (Shepherd et al. 1985), and not enough according the the residents (Minto Villagers 1987).

One additional factor in a trend for declining subsistence use is that more people in Minto depend on outside income and participate to some degree in a cash economy. Easy access to Fairbanks means jobs, places to shop, and medical care. Many young people leave the village permanently (Olson 1981) and return only to visit. Thus, the people are caught in a changing culture that began with the first white contacts and accelerated with the discovery of gold near Fairbanks in the early 1900's. The growing population in Fairbanks over the past 15 years has also meant additional pressure from recreational users on the Minto Flats subsistence base. While conflicts currently are limited, there has been some effect, with more likely in the future.

The overall assessment of the effects of mining on subsistence activities in Minto Flats are stated by Shepherd (1987) as follows:

> " Previous hydraulic mining hastened process of soil deposition on portions of Minto Flats, but was probably instrumental in enhancing habitats favorable to fish and game. Restructuring of the Minto lakes complex into shallower, eutrophic lakes seems to have benefited waterfowl and fish [but not necessarily other animals]. ...Current placer mining in the Minto flats watershed is acknowledged to have contributed to turbidity reaching the Flats, but at levels below standards set for fish and wildlife, and carrying only trace amounts of settleable solids. Declines in productivity and survival of some fish and game species are related to climatic conditions, natural events, and resource management problems.... [thus] a combination of many factors, not a single factor [like mining], may have contributed to changes in the Minto Flats ecosystem, and subsequently the viability of some subsistence resources" (Shepherd 1987).

3.10 Recreation and Visual Resources

For recreation purposes the Minto Flats drainage consists of three separate subdrainages. This evaluation will provide a general outlook for each. The proximity of the various portions of the Minto Flats watershed to Fairbanks and smaller population centers such as Nenana, Minto, Circle, Fort Greeley, Fort Wainwright, Delta Junction. Anderson, Healy, Eielson, Manley, Circle Hot Springs, and Livengood, as well as the comparatively good road access, have allowed for increased recreation uses. Figure 3-9 summarizes the estimated number of stream users.

In 1986 Hellenthal & Associates, Inc. conducted a telephone survey of 1,166 households to measure hunting, fishing, and other outdoor recreational and non-recreational activities in the Tolovana, Chatanika, and Goldstream (and Birch) river basins.

This survey indicates these users have had fairly limited participation rates in these areas. Figure 3-10, a summary of the relative number of household permanent users, shows that 81% and 72% of the households had never been to the Tolovana and Goldstream drainages, and only 43% had been to the Chatanika.

An estimate of the economic value of recreation in the Minto Flats watershed is summarized in Figure 3-11.

	Tolovana River			Chatanika River			Goldstream Creek		
	Pre-1975	1975 to 1983	1984 and 1985	Pre-1975	1975 to 1983	1984 and 1985	Pre-1975	1975 to 1983	1984 and 1985
Commercial Placer Mining	280	254	153	254	382	356	76	25	0
Recreational Gold Panning	458	305	331	1,247	2,061	1,933	661	916	738
Hunting or Trapping	2,493	2,798	1,501	2,824	4,452	3,638	1,018	1,170	1,577
Fishing	6,411	7,810	4,808	16,154	26,585	24,372	2,340	3,307	3,612
Other Recreational Use	5,393	7,200	4,325	14,043	23,939	22,743	7,505	13,534	15,671

Figure 3-9. Estimated number of stream users within the three sub-drainages. Other recreational use includes skiing, snowshoeing, dog sledding, boating, backbacking or other camping, day hiking, picnicking, berry picking, sightseeing, and wildlife or scenic photography. (ADEC 1986b)

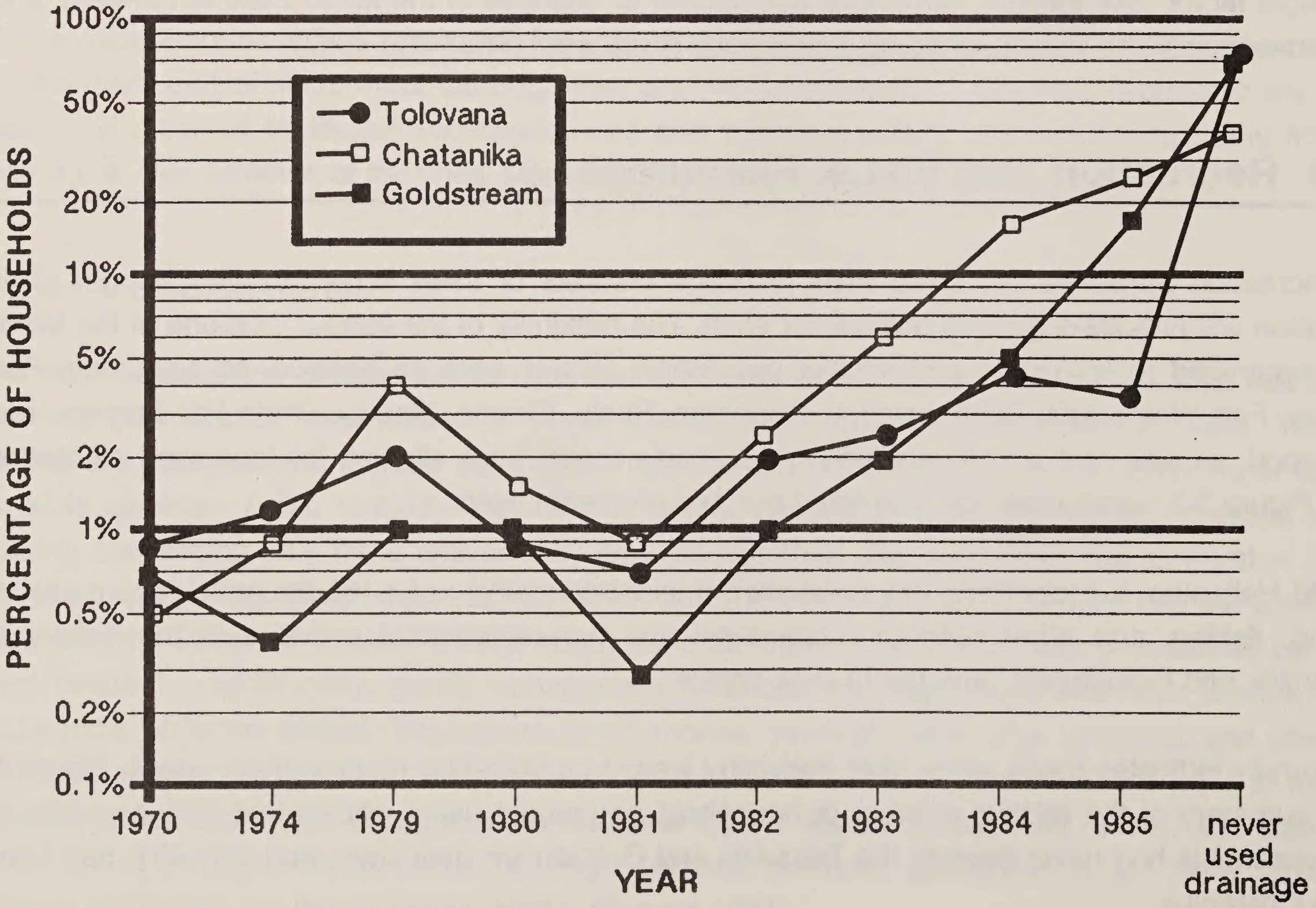

Figure 3-10. Percentage of households using the Tolovana and Chatanika Rivers, and Goldstream Creek.

		Visits	Visitor days		Value	Computed standard
Tolovana River	Hunting	1,501	750.5	X	Standard value $41	= $30,770.50
					Less than standard value $41	= $30,770.50
	Fishing	4,808	1,442.4	X	Standard value $11	= $15,866.40
					Less than standard value $11	= $15,866.40
	Other Recreation Use	4,325	2,162.5	X	Standard value $9	= $19,462.50
					Less than standard value $5	= $10,812.50
Chatanika River	Hunting	3,638	1,819	X	Standard value $41	= $74,579.00
					Less than standard value $41	= $74,579.00
	Fishing	24,372	7,311.6	X	Standard value $11	= $80,427.60
					Less than standard value $11	= $80,427.60
	Other Recreation Use	22,743	11,372.0	X	Standard value $9	= $102,343.50
					Less than standard value $5	= $56,857.50
Goldstream Creek	Hunting	1,577	788.5	X	Standard value $41	= $32,328.50
					Less than standard value $41	= $32,328.50
	Fishing	3,612	1,083.6	X	Standard value $11	= $11,919.60
					Less than standard value $11	= $11,919.60
	Other Recreation Use	15,671	7,835.5	X	Standard value $9	= $70,519.50
					Less than standard value $5	= $39,177.50
	Total	82,247	34,565.0		Total standard	= $438,217.10
					Total less than standard	= $352,739.10

Figure 3-11. Estimate of the economic value of recreation in the Minto Flats watershed.

3.11 Economics

The following discussion is taken from a report by the Alaska Department of Commerce and Economic Development - Office of Mineral Development 1986 entitled "The Role of Placer Mining in the Alaska Economy 1985."

"Expenditures by Alaska placer miners for labor, goods, and services were approximately $75 million in 1985. Of these expenditures, $63.4 million were made in Alaska. About 36% of the total expenditures were made in Fairbanks, and 31% of the workers reside there. Anchorage also plays an important role in the placer mining industry, accounting for 23% of the expenditures and 16% of the work force. Placer mining is a major contributor to the economy of rural Alaska as 34% of the work force comes from rural Alaska and 18% of the total expenditures are made in small communities around the state. Washington and other states play a smaller role in the industry, accounting for 15% of the expenditures and 19% of the labor force.

"Direct employment in the industry is approximately 10,000 person-months and an estimated 2,226 people are involved in the industry on at least a part-time basis. If direct employment is added to this figure, the total employment by the 410 active placer mining operations is estimated to be 20,136 person-months or 1,678 person-years.

"The placer mining industry has a significant indirect impact on the Alaska's economy. The $63.4 million of statewide expenditures had a total impact on sales in the Alaska economy of $127.4 million. The income multiplier results in total wages and salaries resulting from placer mining of $33 million and an estimated 841 people are employed by support industries serving placer mining. These figures demonstrate the importance of placer mining in the Alaska economy.

"Analysis of the input-output models allows estimation of the output, income, and employment multipliers showing the total impact on the economy resulting from placer mining. These multipliers are:

	Output	Income	Employment (per $ million)
Alaska	2.01	2.54	26.5
Fairbanks	1.71	2.14	23.1
Anchorage	1.88	2.49	25.9

"The output multiplier shows the total dollar sales in the economy due to each dollar placer miners spend in Alaska. It allows calculation of the total sales in the economy due to placer mining. These sales are the sum of the placer miners' expenditures and the expenditures made by their suppliers to meet the miners' needs. It includes all rounds of spending.

> "The income multiplier shows the total wages and salaries paid in the economy for each dollar placer miners spend on payroll. It allows calculation of the total salaries and wages paid in the economy due to placer mining, including the initial payroll expenditures by the miners and the payroll of mining support firms that is attributable to placer mining.
>
> "Similarly, the employment multiplier shows the total employment in the economy for each million dollars in the in- state expenditures made by placer miners. It allows calculation of the total employment in the economy due to placer mining. It includes both the direct employment at placer mines and the employment due to sales to placer miners.
>
> "The multipliers are different for each region due to both varying degrees of self-sufficiency and different types of expenditures by placer miners. Since the Fairbanks economy is less developed than that of Anchorage, there is more "leakage" from the region and so the multipliers are lower.
>
> "Based on these multipliers, the total impact on sales in Fairbanks is about $46 million, in Anchorage about $32 million, and in the state as a whole, $127 million. The total impact on salaries and wages in Fairbanks is $9.5 million, in Anchorage $5.5 million, and about $33 million in Alaska. The total impact on employment in Fairbanks is about 625 full time employees, in Anchorage about 438, and in Alaska 1,678."

Current Status

The number of placer mining operations in Alaska has declined each year from 1985 to 1987, while the price of gold and gold mining activity in the rest of the world has gone up. From 1985 to 1986, Alaska gold production decreased 16%, the number of placer mines decreased 27%, 385 Alaska placer mining jobs out of about 2,000 statewide were lost, and the eastern Interior region saw a 49% drop in mining employment.

A major reason for the decline in Alaskan placer mining is the complexity and uncertainty of present and future regulatory requirements, the financial liability associated with these requirements, and the cost of complying with standards. The number of potential permits and approvals required translate into time and expense for the miner. The monetary risks associated with enforcement of current criteria are high, i.e. violators may be subject to $25,000 per day fines. Only those mines having no discharge and those discharging into a large receiving stream can consistently meet the turbidity criteria. Miners carefully consider whether they should borrow capital or buy equipment that will take years to repay if there is a chance they will be shut down in the near future.

The current Court injunctions affecting BLM land could cause an economic hardship on miners using five or more acres. The loss of the 1988 mining season may force some miners out of business if they are unable to repay loans and lose equipment and experienced work crews.

In addition, a miner's decision to operate in the future would be based on the economic principle that a facility's revenues must cover the operating costs. Mine closures would be likely if an operation cannot produce sufficient revenues to cover operating costs.

Early Interior Alaska mining family. Photo courtesly of Anchorage Museum of HIstory and Art.

The decision to operate cannot be made in isolation, and, therefore, a projection of economic loss is not sufficient for closure decisions. Included in the decision to operate are considerations of price expectations, individual operating costs, uncertainty of regulatory controls, closure and restart costs, financial status, and tax loss advantages.

The southern border of the area is just north of Fairbanks and includes many residents who work in Fairbanks. Employment in the southern part of the drainage is largely in Fairbanks, where residents can enjoy a semi-rural lifestyle and the conveniences of a city.

The main communities in the Minto Flats region are Minto, Fox, and Livengood. The Eureka/Manley Hot Springs community is on the western border of the Flats. Fox is a community closely associated with Fairbanks. Its population was 189 in 1985. Minto is primarily an Athabaskan Indian community with a population of about 209 in 1985. Livengood is primarily a mining community with a population of about 21 in 1985.

The population of each of these communities is expected to grow through the next 15 years. In the case of Minto, a decline of population from 1970 to 1980 was due to out-migration. However, Minto is accessible by road and these migration patterns are felt to be temporary (Louis Berger and Associates 1983). Modernization of the village and the construction of Minto Lakeview lodge in 1983 may lead to a decrease in out-migration (Fison & Associates 1987).

The Minto economy is highly dependent on subsistence resources and government spending, including State revenue sharing, capital construction projects, and public assistance. In summer 1986 there were 28 full-time jobs and 54 part-time jobs; only two were not government funded. More than 20 residents made traditional handicrafts and eight residents were involved in trapping (Fison and Associates 1987).

During the summer of 1985 about 19 placer mines operated in the Minto Flats watershed. Employment at these mines was about 57 in 1980 and 63 in 1985. Data from the survey of 1985 placer miners (ADCED 1986) were recompiled by mining district and indicate there were 24 mines operating and many more employees in the Fairbanks and Livengood areas. Person hours were estimated to be 2,440, which is equivalent to 203 full-time employees. Using the statewide average this also suggests about 559 full- and part- time employees (ADEC 1986b).

Most of the hours worked on placer mining were by residents of Fairbanks (53%). Hours worked by employees living in rural Alaska came second with 29%. Total labor costs (wages) amounted to an estimated $2.8 million in 1985.

Total expenditures by miners in the Fairbanks and Livengood districts are estimated to be more than $12.7 million. An estimated 65% of the expenditures are in Fairbanks, 12% in rural Alaska, and 7% each in Anchorage and outside Alaska. Mining in these districts has a significant impact on the residential construction, trade, and eating and drinking industries.

MINTO
FLATS

Chapter IV
Environmental Consequences

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This chapter discusses the potential consequences or impacts of each of the alternatives described in Chapter Two. The intent of this chapter is to provide the scientific and analytical basis of the comparison of the alternatives (Figure 2-5).

Cumulative Impacts

The evaluation of cumulative impacts requires the integration of time, space, mining/non-mining, and federal/non-federal actions in a complex and dynamic environment. The spatial aspect is covered by considering the impacts of multiple mining operations in the Minto Flats watersheds (Placer Mining Operations and Access Roads Map, Chapter Three). Time is considered by evaluating the past, present, and reasonably foreseeable actions of placer mining. Past and present impacts are part of the existing environment, discussed in detail in Chapter Three, Affected Environment. The projected number of mines, acreages of disturbance, and miles of roads and trails were calculated using methods outlined in Appendix B-1, and are summarized in Figures 2-2, 2-3, and 2-4. Future impacts are discussed in this chapter, Environmental Consequences. Impacts from non-federal mines are included in the discussions of current environment and projected impacts. In particular, the impacts of Alternative B, no mining on federal claims, shows the effects from mining on State and private mines. The no-mining actions are discussed in Chapters Three and Four as appropriate.

For a summary of the impacts and comparison between alternatives, reference Figure 2-7, which depicts past, 1987, and projected 1998 impacts for the Proposed Action and each alternative.

Projection of Mines

Thirty-seven mines (12 federal and 25 State and private mines) were projected to be operating in the Minto Flats watersheds (primarily in the vicinity of Livengood, the middle and upper Chatanika River drainage, and upper Goldstream Creek drainage) over the next ten years under the Proposed Action. This number was determined by using a one-to-one relationship between the 1987 price of gold and the number of mines operating during 1987 to predict the number of mines expected to be operating in 1998 with an estimated gold price of $600 per ounce. This estimated gold price was approximately a 23% increase over the highest 1987 price of $475 per ounce, so a corresponding increase in the number of mines was projected for 1998. This level of mining activity was projected so that the cumulative environmental effects of increased mining activity within the drainage could be assessed.

Projecting the number of mines that would operate under Alternative A, was based on the estimated compliance cost of this alternative as compared to the Proposed Action's compliance costs. This cost is listed in Figure 2-6, and comparison clearly indicates that the estimated water treatment cost for Alternative A is significantly higher than that estimated for the Proposed Action. Due to this significant increase in compliance cost, BLM estimated that there would be a reduction in the number of mines operating under these alternative. Under Alternative A, 27 mines (9 federal and 18 State and private mines) were estimated to be operating in 1998. Under Alternative B, no federal mines would be operating, while 25 State and private mines would be operating under the standards of the Proposed Action.

The water treatment costs cited in Figure 2-6 were taken from an EPA report (EPA 1987a) that analyzed the economic impact of effluent standards on the placer mining industry. In the EPA report, six water treatment technology options were outlined and their associated costs for Alaska were estimated. BLM reviewed these options and selected the two treatment technologies that came closest to meeting the various water quality standards of the Proposed Action and Alternative A. The Proposed Action treatment technology would be a simple settling system that consists of primary and secondary settling ponds operated with an EPA variance for turbidity discharge, similar to treatment technology Option Two. Alternative A, with water quality standards of zero ml/l settleable solids and zero NTU turbidity increase, would require operations comparable to the Option 6c of the EPA report water treatment technology, including zero discharge, 100% recycle of process water, and flocculants. For this system, EPA estimated that the operator's income would be reduced by about 27%, so the number of mines was reduced by that percentage. The costs in Figure 2-6 are representative of a mine that processes 150,000 cubic yards per mining season.

A worst-case scenario to describe a level of placer mining more intense than expected, was analyzed to predict those possible cumulative environmental impacts. This scenario could occur if unforeseeable circumstances caused this high level of activity, such as the price of gold increasing to $2,000 per ounce. The summary of this analysis is presented in Figure 2-7 and the assumptions are listed in Appendix B-2.

4.1 Geology and Topography

The scale of surface disturbance of natural topographic features by placer mining and related activities is quite small. Further, such disturbances would be confined principally to redistribution of unconsolidated/semi-consolidated surficial geologic materials, which should generally be amenable to subsequent reclamation. Appreciable portions of streams and riparian areas are subject to frequently rather intensive short-term disturbance but long-term impacts are subject to prevention-amelioration via responsible, substantive reclamation efforts.

The Proposed Action and Alternative A require some reclamation, which would result in little net modification of the overall topography of areas which have undergone mining activities. There would be some short-term impacts, quite local and small scale, of landscape modification during mining activities. Modifications on federal claims should be subsequently reclaimed and yield few or no significant long-term impacts. A principal objective of effective reclamation is to return the landscape to a condition similar to that which existed prior to mining activity disturbances. Thus, as reclamation standards become more stringent from the Proposed Action to Alternative A, effects on topography which involve stream channel and riparian disturbances would be minimized. There should be little likelihood of irreversible or irretrievable commitments of topographic resources, in the sense of appreciable or significant net landscape modification under any of these alternatives.

4.1.1 Proposed Action

Approximately 851 acres of river benches and bottom grounds would be disturbed and 168 acres would be reclaimed within 10 years, with the remainder of acreage on federal claims reclaimed at the end of mine life. Therefore, no significant cumulative impacts on topography, given the required reclamation, are expected.

Direct effects may be significant during actual mining due to disturbance and redistribution of gravel, overburden, and related materials. Indirect effects related to this would be due principally to the possibility of increased erosion of these materials during and after such disturbance.

4.1.2 Alternative A

Impacts would be the same as the Proposed Action, except that 621 acres would be disturbed and reclamation would be required on all federal, State, and private operations.

4.1.3 Alternative B

The cumulative impacts would be similar to the Proposed Action, except that no further federal mining-related disturbance would occur. Mines on State and private lands (575 acres) within the study area would not be affected by this management alternative, hence the impacts would be similar to, but less than the situation under the Proposed Action.

4.1.4 Special Considerations

Unavoidable Adverse Impacts

For all alternatives, there would be some minimal alteration of original site aspect on federal claims, as adequate reclamation does not necessitate attempting to restore the site identically to the original configuration. During mining, the site aspect would be modified to some degree, dependent upon the particular situation; this might be obtrusive in some situations.

Short-Term Uses vs Long-Term Productivity of Resource

For the Proposed Action and Alternative A, there would be some short-term modification of site aspect during mining which would, however, not significantly impact the overall topographic setting of the public lands within the affected area, since the required reclamation would include reshaping and stabilization.

For Alternative B, the situation would generally be similar to the Proposed Action. However, cessation of all mining on federal claims would end further short-term and long-term impingements upon topography from these claims.

Irreversible and Irretrievable Commitments of Resources

For the Proposed Action and Alternative A, there would be no significant irreversible and irretrievable commitments since the required reclamation on public lands would be directed to reshaping and stabilizing the disturbed areas.

For Alternative B, the situation would, in general, be similar to the discussion for the Proposed Action. Cessation of all mining on federal claims would end any further resource commitments relative to these claims.

4.2 Mineral Resources

Alternative A would be more restrictive to mineral resource development than the Proposed Action, while Alternative B precludes mining on federal claims. Thus, the short term impacts are likely to be increased costs and inhibited development of known mineral deposits, resulting from the increasing restrictions under Alternative A. For the short-term, most operations likely would endeavor to cope with these restrictions. Success would vary, depending on a complex of physical and economic factors unique to each location, deposit, and operator. In the long term, there would inevitably be a reduced number of operations, the size and scale of which would need modification. Additionally, the increase of restrictions from the Proposed Action to Alternative A would probably result in some reduced incentive for further exploration and development of new deposits, or extensions of known deposits. Alternative B would extinguish such incentives on federal mining claims.

"Commitment" of mineral resources can be somewhat simplistically construed in one of two ways. One view is that resources not developed, remaining in the earth, represent a "savings account" for possible future use. There is no irretrievable-irreversible commitment of mineral resources from this perspective; they merely remain unused and undiscovered, subject to future events. This view is frequently advocated with the avowed intent of preserving valuable resources for future, presumably more pressing, societal needs, including dire emergencies. However, there is inevitably appreciable time and effort required to obtain a product useful to society from even the known deposits (let alone undiscovered resources) of mineral raw materials in the earth; thus, this interpretation of preservation for future urgent needs is not totally consistent with physical reality. Further, inhibition of mineral resource development in an area inexorably carries with it the corollary inhibition of exploration for extensions of known deposits and/or new deposits. This, in another sense, represents an "irreversible and irretrievable commitment" of undiscovered resources, via ignorance of their existence, to a limbo of non-use by humanity.

Alternatively, development of mineral resources obviously entails physical removal from the earth and "commitment" to other uses, presumably of both physical and economic benefit to human society. The minerals themselves are thus consigned, irreversibly and irretrievably, to human use, including repeated recycling in many instances.

Thus, as restrictions on the development of mineral resources increase from the Proposed Action to Alternative A and Alternative B, the likelihood of "commitment" of the resources, in the first sense as used above increases. Conversely, of course, the likelihood of "commitment" in the second sense as used above similarly decreases. Commitment of mineral resources is most commonly thought of in the second sense, i.e., development; hence, the Proposed Action would be most likely accompanied by maximum commitment, Alternative A less, and Alternative B the least.

4.2.1 Proposed Action

There would be no significant impacts on the development potential of mineral resources.

4.2.2 Alternative A

Impacts would be the same as the Proposed Action.

4.2.3 Alternative B

Mining activity resource development and use would end on federal claims. There would be severe negative impacts on exploration, extension, and development of known and unknown resources on public lands in the area and region.

There would be the direct effect of cessation of mining activities on federal claims, as well as related exploration and development, plus the indirect negative effect on exploration and development in the region and elsewhere in Alaska as well. Known and undiscovered resources which otherwise might have been of value to society would be unused.

4.2.4 Special Considerations

Unavoidable Adverse Impacts

There would be no significant impacts under the Proposed Action or Alternative A, while Alternative B calls for a total cessation of mining and related activities on federal claims.

Short-Term Uses vs Long-Term Productivity of Resource

For the Proposed Action and Alternative A, short-term production of non-renewable resources necessarily implies decreased productivity at some future time. However, without development and use, mineral resources are "resources" only in a somewhat hypothetical sense. In the case of Alternative B, both short-term uses and long-term productivity would effectively be precluded on federal claims.

Irreversible and Irretrievable Commitment of Resources

Mineral resources developed and produced represent irreversible and irretrievable commitments to human use. The resources may be recyclable, but are ultimately non-renewable, in terms of human use. This would be the case for the Proposed Action and Alternative A.

For Alternative B, such mineral resources as may be present on federal claims would be consigned, irreversibly and irretrievably, to a limbo of no development for known resources, and ignorance of existence for presently undiscovered resources. This would be subject, presumably, to possible subsequent changes in law.

4.3 Soils

The initial direct impact to soils from placer mining is the same under all alternatives, the differences lying in the extent of ground disturbed and the measures taken to promote rehabilitation. Generally, placer mining completely destroys the structure of the existing soil profile through the stripping of overburden and processing of gold-bearing gravels. The usual procedure is for the overburden (including organic materials) to be stripped, coarse underlying materials separated from gold-bearing material in the processing plant, and fine materials treated or discharged with the wastewater stream. Three categories of wastes are produced as distinct units: overburden moved to the perimeter of the area of operation, larger rock and soil material deposited as tailings, and fine material collected in settling ponds or discharged with the wastewater stream. Under natural processes recovery from such disturbance occurs gradually over what may be a considerable period. Sidecast overburden begins to recover immediately. Revegetation of undisturbed fine sediments in settling ponds may begin as soon as the ponds are drained. Washed tailing piles, however, differ because they lack fine materials to trap moisture, so revegetation of these features is a very slow process. Initial growth occurs near waterline or where fine materials remain at or near the surface as a result of incomplete processing. Vegetative cover develops gradually in depressions or on the tops of the piles where wind or water-borne fine materials or organics accumulate, or where weathering is sufficient to degrade the coarser materials. Soil development and revegetation of more resistant or exposed areas of the tailings may require decades. The vegetation in such disturbed areas is typical of that which occurs in well-drained, warmer soils.

All alternatives discussed will result in long-term unavoidable impacts to the soil resources in the areas disturbed by mining. The rate of recovery will differ depending on conditions at any given site. The total expected disturbance under any of the alternatives is less than 0.1% of the Minto Flats watershed areas. It is not known what percentage of a particular soil type within the basin will be affected; however, significant changes to the soil resources of the basin are not expected to occur.

4.3.1 Proposed Action

Approximately 851 acres would be disturbed by 1998, with approximately 33% of the disturbance (276 acres) attributable to federal mining operations. Reclamation would occur on 168 acres. The soil profile would be completely altered on all these disturbed areas. Disturbance of the soil profile and/or compaction of soils on an additional 16 miles of road are anticipated. All federal operators would be required to stabilize the site and the stream channel. Operators on State or private claims would not be required to perform this reclamation. As a result, federal claims should show reduced rates of erosion but would not generally show the initiation of a productive soil materials for approximately 50 years. Locations devoid of fine material would develop extremely slowly if at all with little or no vegetation being established in the near future. Areas containing fine material would develop a productive vegetative cover relatively rapidly, but would be subject to high rates of erosion until a successional plant community is established. Approximately 575 acres would not be subject to this reclamation requirement. Areas not stabilized would continue to erode. The development of productive soil materials and reestablishment of vegetation would be retarded in these areas.

There is no possible way to mitigate the disturbance of the soil profile if placer mining takes place under current practices. The only measures that can be taken are the differing reclamation practices addressed in the alternatives. Under the Proposed Action, overburden would be stockpiled and respread after mining. This would shorten the recovery period for reestablishment of soil materials and vegetation. Mitigation for access could include requiring all access to occur during conditions of frozen ground and adequate snow cover, proper location of access routes, minimizing the amount of vegetation and soils disrupted, channel crossing provisions as appropriate, and runoff control on barren road surfaces.

4.3.2 Alternative A

This alternative essentially provides for restoration of the disturbed areas by all operators in the watershed. Approximately 621 acres would be disturbed by 1998, including 207 acres on federal claims. The stream channel would be restored, disturbed areas would be recontoured with the fine material redistributed, and vegetation would be reestablished on the site. This would provide for a relatively rapid development of productive soil materials and reduce the potential for non-point source pollution (erosion and sedimentation) to minimal levels. Mitigation would be the same as under the Proposed Action.

4.3.3 Alternative B

All areas disturbed after 1980 on federal mining operations would be stabilized and no new disturbance would occur on federal mining claims. This would result in impacts similar to the Proposed Action except there would be no further disturbance on approximately 15% of the mining claims in the watershed. Mining would probably continue on the State and private claims in the area, resulting in approximately 575 acres of disturbance by 1998. Federal claim areas would generally not exhibit accelerated erosion and should provide for the development of productive soil materials in reclaimed areas where fine material is available in approximately 30 years. Soil development would be retarded in those areas where fine sediments are unavailable, as identified in the foregoing discussion. There are no mitigating measures for soil resources which would be implemented under this alternative.

4.3.4 Special Considerations

Unavoidable Adverse Impacts

Under the Proposed Action the soil profile would be completely altered by mining operations on approximately 851 acres of ground. Soil resources would be impacted by access on approximately 58 miles of roads through disturbance of the soil profile and compaction. Soil loss would necessarily occur on areas of surface disturbance, but this would be minimized by the requirement to save and stabilize overburden. Sidecast materials would temporarily alter the surface response to precipitation, as well as local relief.

The soil profile under Alternative A would be completely altered by mining operations on approximately 621 acres of ground. Soil conditions may be impacted by access roads through disturbance of the soil profile or by compaction. Increased soil loss would occur on all areas of surface disturbance until restabilization occurs. Sidecast materials would temporarily alter the surface response to precipitation, as well as local relief.

Under Alternative B the soil profile would be completely altered on approximately 575 acres of ground by mining operations on State claims or private lands. Soil conditions may be impacted by access roads through disturbance of the soil profile or by compaction. Increased soil loss would occur on areas of surface disturbance.

Short-Term Use vs Long-Term Productivity

Under the Proposed Action and Alternative A the disturbance of the soil profile for placer gold recovery would result in the temporary loss of vegetative production and lack of availability of the disturbed areas to potential users such as wildlife. The redevelopment of soils may result in increased species diversity over the long term (see Chapter 4.5, Landcover). Under the Proposed Action, research indicates the initiation of a productive soil base within 50 years if reclamation practices are adhered to. Under Alternative A a productive soil base would eventually develop in 25-30 years if reclamation practices are adhered to. Restoration of existing soil profile for affected acreage may require centuries.

There would be no additional effect to soil productivity as a result of mining operations under Alternative B. Short-term use on federal claims would be limited to reclamation activities. Activities on other claims in the area (approximately 66% of the current mining activity) would be unaffected. Recovery of soil resources on federal claims would be underway within a period of 30 to 50 years.

Irreversible and Irretrievable Commitment of Resource

The irretrievable commitment of soil resources on mining claims affected under the Proposed Action and Alternative A would include those soils moved off-site by erosion. Soil profiles would be completely disrupted in the areas affected.

Under Alternative B, depending on the reclamation practices used on the State and private ground, reestablishment of a productive soil base could take 50 years or more. There would be no further irreversible or irretrievable commitment of soil resources on federal claims.

4.4 Water Resources

Cumulative impacts to water resources in the Minto Flats drainage as a result of mining activities will continue to occur under all of the alternatives. This is in part due to mining operations in the basin which are not on federal claims, as well as current basin conditions. State mitigation and reclamation requirements are less restrictive than those applied to federal claims. With the exception of impacts to surface waters, mitigation and reclamation on private claims is at the discretion of the owner. Implementation of the regulations for discharge of dredge and fill materials to wetlands and navigable water bodies is being initiated by the Army Corps of Engineers. The revised EPA water quality criteria for placer mining will be final later in 1988. The impact of these actions on current methods of operation remains to be seen; however, more stringent discharge requirements are evaluated under Alternative A.

Because placer mining is generally a non-consumptive use of water, there would be no significant impact on the overall water quantity of the Minto Flats basin by process water diversions under any of the alternatives. Localized decreases in water quantity will occur between the intake and outfall at each operation. Other changes may occur through cementation of the streambed with sediment as discussed in Chapter Three. This effect is not possible to quantify with existing data. It was noted that those streams which were affected by mining characteristically exhibited higher runoff than those unaffected. Although the study results are consistently with such a phenomenon, this may be coincidental (Bjerklie and LaPerriere 1985). Response time would be decreased by such factors as shortening the length of the channel, increasing total surface water by creating tailing ponds, reducing channel roughness by sedimentation, decreasing retention by removal of the vegetative mat, and increasing percolation by removing fines in terrestrial substrates. Response time would be an increased by such factors as increased active layer resulting from the thawing of the soils and removal of impermeable clay strata, and diversion and retention of surface flows in process water treatment systems.

Some direct effects on water quality can be anticipated during the development stage of an operation due to the construction of settling ponds and stream bypasses and through rechannelization of the stream if required. This would result in short term increases in sediment levels and turbidity while equipment operates in the active channel. During the production phase of most operations discharge of sediments to the stream will occur through the process water treatment system as well as from non-point input from disturbed areas. It is also likely that occasional high water or failure of water control structures would introduce sediments which are collected by the water treatment system to the stream channel. This would create short- term increases in turbidity levels and possible downstream sedimentation of the stream substrate. The degree of impact from such an occurrence would depend on the amount of material released from the site and the flow at time of release. A treatment system breach under normal or low water stream conditions would likely be detectable downstream for short periods. A treatment system breach or non-point discharge during a storm would have a minor impact given existing stream conditions.

Indirect impacts to water quality will occur through accelerated erosion from placer operations. These impacts are expected to continue until cessation of mining activities and successful revegetation of the site is achieved. Channel cutting will also occur until the stream reaches equilibrium. These processes will introduce sediment to the stream system, particularly during the spring breakup and floods, which may result in stream bed elevation or lowering of the piezometric surface and subsequent isolation of surface and ground waters. The degree of impact is unknown.

4.4.1 Proposed Action

Channel morphology would be directly affected in all areas where activities associated with mining occur in the active channel. Localized impacts to the biological community as a result of in-channel operations such as diversion and subsequent mining would occur. From the estimates presented in Figure 4-1, there would be approximately 3 miles of channel affected on federal claims and 6.25 miles of channel affected on State and private claims. Water quality would be affected during this process through the introduction of organic and inorganic constituents to the water column. This can result in both short- and long-term impacts.

Under this alternative, by 1998 water quality would probably be worse than that which existed during the 1987 mining season due to the projected increase in the number of operations and total surface area affected. Mining operations would continue to meet both settleable solids and turbidity standards (including EPA variances) most of the time. Retention of settleable solids on placer mining sites would help minimize cementation of the stream bed and the resulting aggradation of the stream channel, isolation of surface and ground water, and changes in channel morphology. It is likely that occasional high water or failure of water control structures would introduce sediments collected by the water treatment systems into the stream channel. The degree of impact from such occurrences would depend on the amount of material released from the site and the streamflow at the time of release. Releases resulting from high flows should be less persistent than those resulting from other causes. Increased levels of turbidity would occur on all actively mined streams with mines operating under EPA variances. Current data indicate that such input may have a significant impact on biological communities.

Indirect impacts on water quality would occur through accelerated erosion from disturbed areas until these areas are fully stabilized. Channel cutting and resuspension of particulates would also occur until the stream reaches equilibrium. These processes would introduce sediment to the water column, particularly during spring breakup and floods. By requiring federal operators to stabilize their site of operations there should be a reduction in the amount of erosion, and the corresponding sedimentation and turbidity introduced, from these non-point sources. It is likely that current impacts to water quality would continue at a somewhat increased level for the following reasons:

1) the total number of operations would probably increase

2) federal operations represent only a portion of the total number of operations in the watershed, and

3) similar requirements would not be in effect on State and private claims These impacts could be expected to gradually decrease after cessation of all mining until successful revegetation of the disturbed areas and flushing and/or stabilization of the channel has occurred. It is projected that revegetation would take 30 years on federal claims and 50 years or more where such reclamation does not occur (Landcover, Section 4.5). Channel stabilization and flushing of the stream bed, where such may occur, would depend on the occurrence of a low period flood (25 years or greater). In the smaller tributaries and low gradient areas, natural restitution may never occur. There is no information in the current literature on the production of sediments from roads and trails in the basin. The primary sources of sediment would be stream crossings; roadways directly adjacent to stream channels; improved roads and trails which converge down-gradient to stream channels and which lack runoff control or sediment traps; and recreational, commercial, and residential development. There are substantial amounts of road segments along the stream channel of the upper Goldstream Creek and the Chatanika River.

The quantity of sediment moved within or through the system by the drainages within the Minto Flats area due to natural causes, mining, or other disturbances is not definable with the current data. For comparative purposes, under this alternative, BLM estimates that the soil loss from the Minto Flats watershed from natural erosion and non-point sources is approximately 13,070 tons per day based on a 200 day open water season (Figure 4-1). It is expected to increase to 13,220 tons per day by 1998. This estimate is consistent with that derived from Selkregg (1974).

Conclusions

Meaningful predictions of impacts from turbidity and the sedimentation of the streambed are not possible. However, available data indicate that the discharge of particulates from active, operating mines may make a significant contribution to water quality deterioration in the watershed, particularly on Goldstream Creek. Elevated levels of certain chemical constituents can be expected as discussed in the chapter introduction. The contribution of sediment from the non-point sources is unknown and cannot be adequately segregated or distinguished from mining point-source with the existing data.

4.4.2 Alternative A

Some direct effects on water quality can be anticipated during the development stage of an operation due to the construction of settling ponds and stream bypasses, and through rechannelization of the stream if required. This would result in short term increases in sediment levels and turbidity while equipment operates in the active stream channel, and during the period required for stabilization. During the production phase of operations, if "zero discharge" was truly attained, there would be no direct impact on water quality from mining operations. However, it is likely that occasional high water or failure of water control structures would introduce sediments collected by the water treatment system into the stream channel. This would create short term increases in turbidity and TSS levels and possible localized sedimentation of the stream substrate. The degree of impact would depend on the amount of material released from the site and the streamflow at the time of release. Restoration of the stream channel would occur on federal claims. This would reduce the time required for channel recovery in those areas affected.

Projected Annual Tonnage Rates for Sediment in 1998[1]

Category	Proposed Action	Alternative A	Alternative B
Forest	74,400	74,400	74,400
Abandoned Surface Mines[2]	6,552	6,552	6,552
Active Federal Surface Mines[3]	20,700	15,525	0
Active State Surface Mines[3]	43,125	31,050	43,125
Construction[4]	4,327	3,158	3,435
Other Construction[5]	2,495,000	2,495,000	2,495,000

[1] Calculated using estimates prepared in table 3-1.

[2] Assumed that no regrowth and regeneration occur (worst case).

[3] Assumes disturbances continue past 1998, but total reclamation at end of mine life.

[4] Construction of roads and other disturbances will contribute less sediment on successive years - but is not calculated here.

[5] Estimated to include 46.8 square miles of housing and development and 5.1 square miles of major roads such as the Steese and Elliott Highways.

Figure 4-1. Comparison under the alternatives of projected 1998 annual tonnage rates for sediment for various categories in Minto Flats.

Indirect impacts on water quality would occur through accelerated erosion from disturbed areas. Production of sediment from the channel would also occur until the stream reaches equilibrium. These processes would introduce sediment into the stream system, particularly during spring breakup and floods, until successful stabilization and revegetation occurs (Landcover, Section 4.5). Impact from federal operations would largely be limited to non-point source discharge from storms or accidental discharge from disrupted water treatment systems.

The impact on chemical water quality is similar to that discussed under the Proposed Action. The additional mitigation and reclamation required should result in a decrease in the contribution of mineral and organic constituents from operations on federal claims. It is not currently possible to quantify the impact on water resources downstream with the data available.

For comparative purposes, under this alternative BLM estimates that the sediment load from the Minto Flats watershed from natural erosion and non-point sources would be approximately 13,128 tons per day based on a 200 -day open water season (Figure 4-1) Approximately 2.25 miles of stream channel on federal claims and 4.5 miles of stream channel on State claims and private mines would be affected by mining operations.

Conclusions

The effect of placer gold mining on downstream uses is evaluated in other parts of this document. The primary source of sediment input would be from non-point sources on unstabilized ground or uncontrolled discharges from processing systems. The impact on chemical constituents is unknown.

4.4.3 Alternative B

Indirect impacts on water quality would occur through accelerated erosion from areas disturbed until fully successful revegetation of the site is achieved. This could take at least 50 years on unreclaimed sites and 30-50 years on sites where reclamation measures are taken. Channel cutting would also occur until the stream reaches equilibrium. These processes would introduce sediment to the stream system, particularly during spring breakup and floods. Contributions from active placer operations would continue on most of the currently affected drainages due to the presence of a substantial number of State claims and private mines.

For comparative purposes, under this alternative BLM estimates that the soil loss from the Minto Flats watershed from natural erosion and non-point sources would be approximately 13,123 tons per day based on a 200 day open water season (Figure 4-1).

Conclusions

Under Alternative B, mining would cease on federal claims, and post-1980 surface disturbance would be reclaimed. Sediment input from federal claims would decline until stabilization of disturbed sites occurs. Sediment input from State claims and private mines would continue much as in the past. Stabilization of the stream channel would be enhanced by reclamation measures taken on federal claims. Impact to chemical water quality should be much the same as under Alternative A and the Proposed Action, however there should be a reduction in the concentration of chemical constituents.

4.4.4 Special Considerations

Unavoidable Adverse Impacts

Unavoidable adverse impacts are short- to long-term increases in suspended sediments and turbidity, accelerated erosion from disturbed areas resulting in a secondary increase in sediment introduced to the stream system, and changes in channel morphology in the vicinity of the disturbed areas. With the exception of sediments that have settled in the stream channel and other depositional zones, discharged sediments are flushed by annual breakup or floods. Deposition in the downstream areas would continue. It is expected that there would also be an increase in some mineral and organic constituents, and localized reductions in flow between intake and outfall. No information is currently available on the sediment deposition into the stream channel. Available data indicate that although there is an increase in certain constituents there is not a significant impact to chemical water quality in the basin due to mining activities because of dilution. This situation is expected to continue under all of the alternatives evaluated. There is, however, an effect on fine particulate load transported, particularly on Goldstream Creek.

Irreversible and Irretrievable Commitment

As identified above, it is not known whether, when, or to what extent the stream channel would recover from existing impacts. Water quantity is not likely to be significantly affected, and water quality would return to approximately natural conditions after successful stabilization of the disturbed area and stream channel. Apparent deposition of fines in the Minto Flats area would continue and persevere. Information available on the resultant changes is presented in other sections of this document.

Short-Term Use vs. Long Term Productivity

The long-term productivity of the stream would be affected by placer operations until stability and equilibrium are reestablished. Channel shortening in the upper reaches of the drainage would remain after cessation of mining, until the occurrence of a low-period flood. Cementation of the stream bed and isolation of the surface and subsurface waters may be the situation in the Minto Flats drainages, as on other streams impacted by mining operations, and if present, would continue until the occurrence of a major event as well. Sediment deposition would gradually decline until stabilization of stream banks and reestablishment of the stream channel occurs.

It is expected that there would be continued changes in the morphology of Goldstream Creek, the Chatanika River, and possibly the Tolovana River in those areas where the streams lose energy as they enter Minto Flats, and where the high resuspended sediment loads carried in these waters settle out. This effect would continue until the sediment load decreases to levels where the stream energies are sufficient to carry the load through the system. For comparative purposes, it is estimated that non-point source soil loss from the watershed due to mining operations could be as little as 1% to 3% of the total non-point soil loss (Figure 4-1). The non-point source soil loss from non-mining construction activities could be as great as 90% or more of the total non-point source loss. It should be pointed out that this is the total loss for the watershed area and all of this material does not necessarily enter the stream system. The quantity of sediment moved within or through the system by these streams is not definable with the current data.

4.5 Landcover

Analysis of acreages affected by mining and reclamation is based on projected disturbance for mining and associated claim access roads and trails (Appendix D-1). Estimates of acreages for all alternatives are in Figure 4-2.

Sandhill Crane

The major variation among alternatives which will affect landcover is the relative amount of fine materials remixed in the tailings during reclamation. This fine material content affects both the rate of regrowth and the acreage which will recover to a stable productive vegetative community.

Figure 4-3 illustrates various rates of succession on substrates with different percentages of sub-sand-sized fine materials. Analysis of the impacts of the alternatives is therefore largely based on the differing regrowth rates resulting from different reclamation techniques and the mix of fine materials in the tailings.

Figure 4-3 was developed using data from studies and observations of regrowth on tailings (Rutherford & Meyer 1981, Holmes 1981, Halloran 1986, Spencer 1987). The four arrowed lines represent average time frames for succession to various vegetation communities. Most disturbed areas in the Minto Flats watershed will follow this or a similar pattern of native species regrowth. Cumulative effects become apparent when the disturbed area is large enough to influence seed dispersal into barren ground, or when repeated disturbances such as remining old tailings maintain one of the pioneering communities.

A stable, sustaining productive community is considered to be the open tall shrub community, shown on Figure 4-3. This is generally a tall willow and/or alder community with a canopy cover of at least 50% in vegetated areas, where dying vegetation is replaced by seed or vegetative means. Such a community can sustain moderate pressure from wildlife, especially beaver or browsing moose, and may continue on the site indefinitely, or be successional to a deciduous forest with mixed spruce.

Mining prior to 1981 has resulted in surface disturbance to approximately 3,742 acres in the watershed. Two hundred fifty acres are used for roads.

4.5.1 Proposed Action

During 1987, a total of 260 acres were disturbed by mining activities in the Minto Flats watershed on federal, State, and private mining claims. Claims on federal lands accounted for 155 acres, with approximately half of this area on previously-mined tailings. Fifty acres were reclaimed on federal lands

		Acres disturbed from mining	Acres disturbed from roads	Acres reclaimed	% barren after regrowth on reclaimed land	% barren after regrowth on unreclaimed land	Acres barren after regrowth	Acres barren from all mining & roads	Acres of successional community on dredged tailings	Acres of successional community on new ground
Pre – 81		3,742	250			85%	3,181		561	
1987	Federal (old)				85%	85%	66		12	
	Federal (new				75%	75%	60			17
	Total federal	155	181	50			126			
	State (old)				85%	85%	45		8	
	State (new)				75%	75%	38			14
	Total state	105	69	5			83			
	Joint road		0							
	Total	260	250	55			209	3,640	581	31
Proposed Action	Federal (old)				85%	85%	117		21	
	Federal (new)				40%	75%	74			64
	Total federal	276	253	168			191			
	State (old)				85%	85%	244		43	
	State (new)				40%	75%	216			72
	Total state	575	97	0			460			
	Joint roads		0							
	Total 1998	851	359	168			651	4,182	625	136
Alternative A	Federal (old)				85%	85%	66		38	
	Federal (new)				75%	75%	55			48
	Total federal	207	184	126			121			
	State (old)				85%	85%	132		75	
	State (new)				75%	75%	111			96
	Total state	414	71	252			243			
	Joint roads		0							
	Total 1998	621	255	378			364	3,800	674	144

CONTINUATION

		Acres disturbed from mining	Acres disturbed from roads	Acres reclaimed	% barren after regrowth on reclaimed land	% barren after regrowth on unreclaimed land	Acres barren after regrowth	Acres barren from all mining & roads	Acres of successional community on dredged tailings	Acres of successional community on new ground
Alternative B	Federal (old)				85%	85%	0		0	
	Federal (new)				40%	75%	0			0
	Total federal	0	180	0			0			
	State (old)				85%	85%	244		43	
	State (new)				40%	75%	216			72
	Total state	575	97	0			460			
	Joint roads		0							
	Total 1998	575	277	0			460	3,918	604	72

Figure 4 – 2. Acreage estimates for impacts of placer mining on landcover. Disturbance of "old" ground refers to previously mined, often dredged, areas. "New ground is previously unmined, and revegetation estimates are based on sluicing operations. "State" includes claims on state land and all private operations. Blank spaces indicate data not applicable or not available.

by reshaping tailings, and respreading topsoil where available from new mining ground. State and private operations covered 105 acres, with reclamation on five acres documented in the Annual Placer Mining Applications (APMAs).

Regrowth to a stable sustaining shrub community on mined new ground would take approximately 30 years. Areas which are being mined on old tailings have little to no topsoil and overburden to spread over the reshaped tailings. The lack of fine materials in the reclaimed tailings would retard rapid regrowth of vegetation. Regrowth to a stable, sustaining productive community of tall shrubs would take approximately 50 years (Figure 4-3). Prior to that, this area will have low value for big game habitat, especially for use as winter moose browse (Section 4.6).

As future mining operations disturb new ground, topsoil and overburden may be available for respreading over the tailings. The length of time to grow to a stable, productive shrub community would be approximately 30 years for disturbance on new ground. Further disturbance on old tailings would take approximately 50 years for regrowth. The difference in regrowth rates is largely attributable to the higher proportion of fine-grained materials in tailings from mining new ground.

Under the Proposed Action, 850 acres of additional mining disturbance are projected by 1998. Claims on federal lands are projected to disturb 276 acres, with an additional 575 acres of disturbance on State and private lands. Of these disturbed acres, 168 would be reclaimed on federal

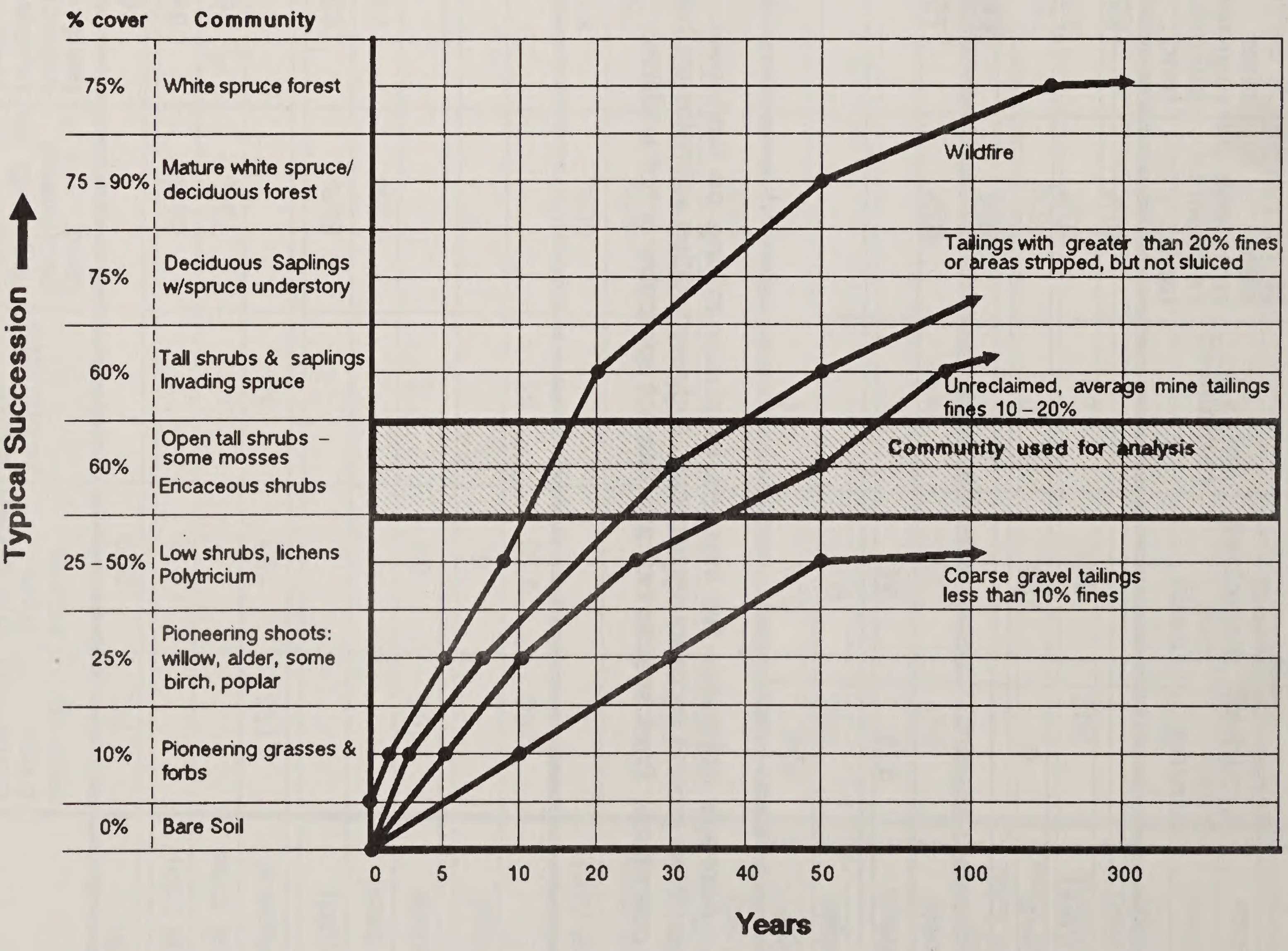


Figure 4-3. Comparison of succesion rates after various reclamation approaches and natural wildfire.

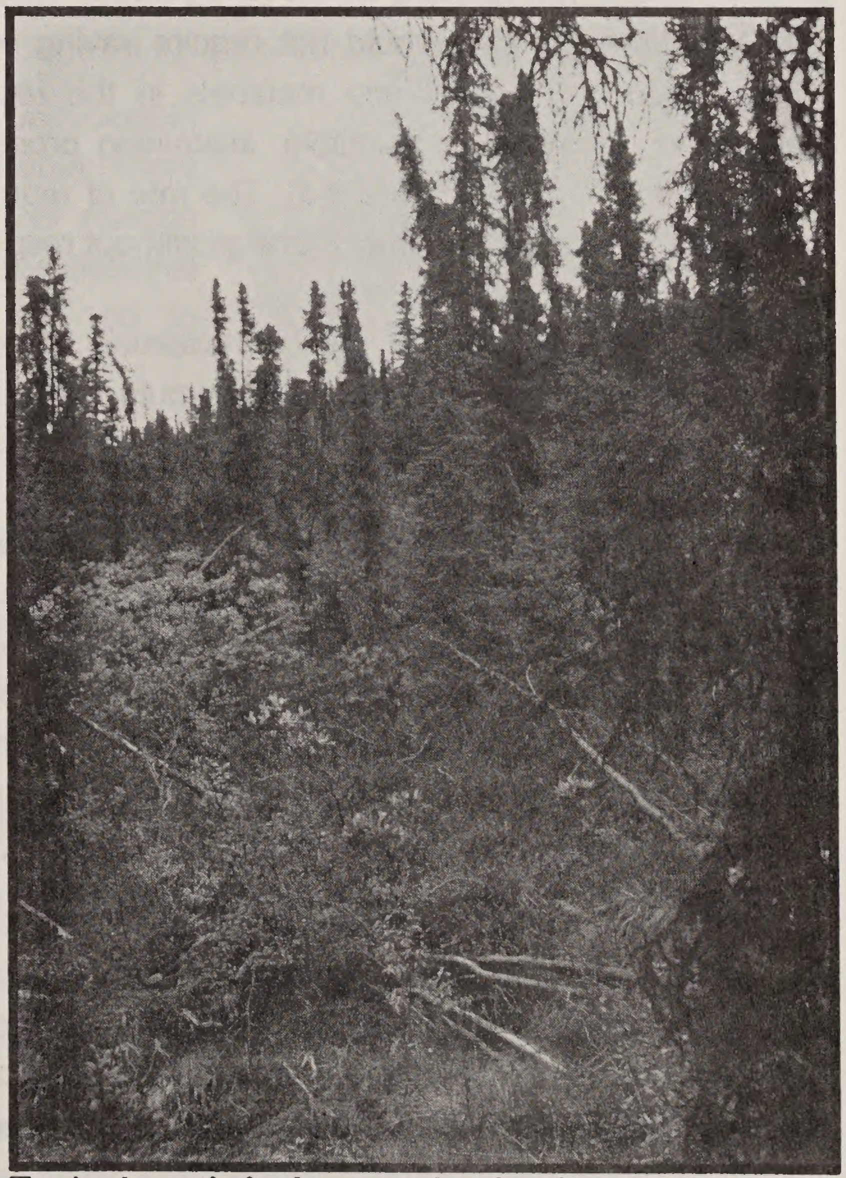
claims. Projected mining activity would probably be concentrated in the upper tributaries of Faith and other creeks in the headwaters of the Chatanika River, the upper tributaries of Goldstream Creek, and streams near Livengood on the Tolovana River. Using the calculations discussed in Appendix D-1, 136 acres would regrow to a riparian tall shrub community within 30 years of reclamation, and an additional 64 acres within 50 years on mining disturbance in creek bottoms. Six hundred and fifty-one acres of new mining disturbance would remain barren or sparsely vegetated.

The roads would remain barren indefinitely, removing 350 acres of upland vegetation. The probable routes of these roads generally transect stands of mature deciduous forest, sparse black spruce with willow patches, and low and dwarf shrub tundra.

4.5.2 Alternative A

Alternative A would require that topsoil and overburden be saved and respread over reconfigured tailings. With the mining in old tailings, another source of fines is necessary to facilitate natural revegetation on the site. One possible source would be to use fines from the abandoned settling ponds. Further enhancement such as fertilization and seeding could be required by BLM in approving individual Plans of Operation. Neiland (1978) and Peterson and Peterson (1977) point out that fertilization and seeding with domestic species tends to encourage non-native species at the expense of invasion and establishment by native species. Both suggest a combination of techniques to facilitate vegetation quickly to reduce erosion, and to enhance eventual establishment of a community of native plants. Mowatt (DOI 1987d) outlines many mitigation techniques for preparing soils, and considerations for revegetation of tailings during reclamation. The details of this work would have to be site-specific, and specified in the individual Plans of Operation for the mine.

On sites where a variety of techniques are used, including mixing of settling pond fines in the tailings, fertilization, seeding, and mulching to enhance regrowth; a stable, sustaining community of tall shrubs would be established in approximately 25-30 years. Permanent barren area would be reduced to approximately 50%.



Typical north-facing unmined sideslope consisting of black spruce, willow, and sphagnum moss.

Under Alternative A an additional 621 acres of mining disturbance are expected by 1998. Two hundred seven acres are projected for mining on federal lands, with 414 acres on State and private lands. Reclamation would occur on 126 acres of federal claims, and 252 acres of State and private lands. Projected mining activity would probably be concentrated in the tributaries of Faith Creek, Goldstream Creek, and sections of the Tolovana River. Using the calculations discussed in Appendix D-1, 144 acres would regrow to a riparian tall shrub community within 25 years of reclamation, and an additional 113 acres would regrow within 50 years on mining disturbance in creek bottoms. Three hundred and sixty-four acres of new mining disturbance would remain barren or sparsely vegetated.

The roads would remain barren indefinitely, removing 255 acres of upland vegetation. The probable routes of these roads generally transect stands of mature deciduous forest, sparse black spruce with willow patches, and low and dwarf shrub tundra.

4.5.3 Alternative B

Under this alternative there would be no further mining on federal claims in the watershed. Reclamation for this alternative would not require saving or respreading available topsoil over the tailings. The consequent lack of fine materials in the reclaimed tailings would retard rapid regrowth of vegetation. Regrowth to a stable, sustaining productive community of tall shrubs would take approximately 50 years (Figure 4-3). The rate of regrowth on reclaimed areas would be similar to the rate on unreclaimed washplant tailings without respreading of stockpiled topsoil and overburden.

Existing old tailings would not be reclaimed because there would be no further mining in those gravels. Future impacts listed below would come from mining on State claims and private lands; past impacts would carry over from historical mining on all lands.

Under Alternative B, no additional acreage of mining disturbance on federal lands is expected by 1998. Non-federal operations are projected to disturb an additional 575 acres, with no reclamation requirements. Regrowth by natural processes on new mining would take 40 to 50 years, depending on the location of the disturbed area. Regrowth to a tall shrub community from mining on new ground would total 72 acres. An additional 43 acres would regrow on old tailings in approximately 50 years. The roads would remain barren indefinitely, removing 277 acres of upland vegetation. A total of 3,918 acres would remain barren or sparsely vegetated for a long period, including 3,181 acres of old tailings, 277 acres of roads, and 460 acres from new mining on non-federal lands.

4.5.4 Special Considerations

Irretrievable and Irreversible Commitments of Resource

Not all disturbed areas become revegetated, rather some remain barren or sparsely vegetated for long periods (over 90 years) after mining and reclamation activities are complete. The amount of ground remaining barren depends principally on the the proportion of fine-grained materials in the reclaimed tails, and on other site- specific factors. Under the Proposed Action, a total of 4,182 acres would be left barren. The barren area includes tailings from past mining (3,181 acres), new mining (651 acres), and all roads (350 acres). A certain amount of barren acreage would be an irretrievable and irreversible loss of vegetation resources under all the alternatives.

Under Alternative A, 3,800 acres would be left barren, including tailings from past mining (3,181 acres), new mining (364 acres), and all roads (255 acres).

Under Alternative B, a total of over 3,918 acres would be left barren. This includes tailings from past mining, new mining on State and private lands, and all roads. This barren acreage is an irretrievable and irreversible loss of vegetation resources.

Unavoidable Adverse Impacts

During mining operations, the vegetation cover is destroyed in the areas of the mine and roads, resulting in a short-term unavoidable loss of productivity. Under the Proposed Action there would be a long-term cumulative unavoidable loss of 4,181 acres of the vegetation cover of the area.

Under Alternative A there would be a long-term unavoidable loss of 3,800 acres of the vegetation cover of the area. There would also be an unavoidable loss of the original riparian community, which is replaced by an earlier successional community, and soils, including permafrost, for 100 to 200 years.

Under Alternative B there would be a long-term unavoidable loss of over 3,918 acres of the vegetation cover of the area. There also would be an unavoidable loss of the original riparian community, which is replaced by an earlier successional community, and soil structure, including permafrost, for 100 to 200 years.

Porcupine

Short-Term Use vs Long-Term Productivity of Resource

Most of the existing mining disturbance in the Fairbanks District dates dates from 1905 to present. The area has regrown with a mosaic of barren and sparsely vegetated types, and tall shrubs. The sites which have regrown to a community of open tall shrubs of willow, birch, and balsam poplar have the same or higher productivity than that of the original riparian community on the site. This regrowth has taken approximately 50 to 70 years since mining disturbance (Figure 4-3). As succession proceeds further toward mature deciduous or white spruce forest, productivity would gradually decline.

4.5.5 Threatened and Endangered Flora

Within the Minto Flats drainage study area there are currently no "listed" or "candidate" threatened or endangered plant species. There are no plant species considered endemic by BLM. If assessments of proposed action sites, were to reveal endemic species, the existing surface management regulations, 43 CFR 3809.2-2(d), apply. Therefore the cumulative effects upon any endemic plant species would be the same for all alternatives. The following measures are presented to better understand the affects and measures taken if a vulnerable species is identified within this vast region of Interior Alaska.

BLM policy is to protect, conserve, and manage federally and State-listed T/E plant species and candidate plants, and to use existing BLM authority to further the purpose of the Endangered Species Act and similar state laws. BLM will ensure that actions authorized, funded, or carried out will not jeopardize the continued existence of such species or result in the destruction or adverse modification of their critical habitats. Specifically, BLM will: 1. Evaluate information to determine the distribution, abundance, reasons for current status, and habitat needs for candidate species on BLM lands, and the significance of BLM lands and actions in maintaining those species. 2. Evaluate all information to determine whether it is adequate to make informed management decisions (BLM Manual Section 6840). Priority is given to species for which significant adverse impacts are anticipated or for which there is a high risk in not knowing population trends. The effectiveness of the initial habitat assessment for the proposed action is vital to the survival and conservation of these species.

4.6 Wildlife

The degree of impact to wildlife habitat and populations resulting from mining-related activities depends on the location, timing, and frequency or extent of the activity. The format adopted to analyze and discuss the impacts of the Proposed Action and alternatives on wildlife resources includes those factors common to all alternatives and those specific to the Proposed Action and each alternative.

Analysis Approach

For the purpose of this analysis, mineral development activities were broken down and categorized into components. The major action components used to assess the environmental consequences of the Proposed Action and alternatives on wildlife resources were access, facilities, and operations (Figure 4-4).

In the analysis of the effects of access BLM considered the type of vehicle(s) involved, material(s) being transported, location and length of access route, and how often the route would be used in the present and future. Subcomponents considered under facilities include the number and size of structures; the size of pad(s); the timing, frequency, and duration of human activity; the type and amount of waste produced; and the frequency of waste disposal. Distinct aspects of the operation

ACCESS	FACILITIES	OPERATIONS
Type(s) of vehicle(s) Materials transported Location & length of route Frequency of current route use Frequency of future route use	Number & size of structures Size of pad(s) Number, timing & duration of people present Type & amount of waste produced How often waste is disposed of	Type/amount of equipment Timing & duration of equipment operation Size of area stripped Size of area mined Size of various stockpiles Settling basin number & size Size of other surface disturbance

Figure 4-4. The three major components and subcomponents of mineral development used to assess impact on wildlife by the Proposed Action and the alternatives.

component included the type and number of equipment used, timing and overall duration of equipment use, size of the area to be stripped, size of the area to be mined, size of various stockpiles, number and size of settling basins, and the size of any other surface disturbances. In this analysis BLM assumes that mitigation measures or guidelines for State and private mining activities are similar to those required for federal operations, except for reclamation (Section 2.3).

General Impacts

The general potential impacts from the access, facilities, and operation components on the wildlife resource are identified in Figure 4-5. The levels of impact attributable to federal, State, and private mining activities for the Proposed Action and alternatives were subsequently determined and are presented in detail in Sections 4.6.1-4.6.3.

Potential impacts resulting from access include removal of wildlife habitat due to roads and trails, disturbance and/or disruption of wildlife movements and seasonal use areas due to vehicular traffic, increased harvest pressure and other recreation use, and habitat destruction because of new or improved access into remote areas.

The potential impacts resulting from the facilities component are elimination of wildlife habitat due to the construction of gravel pads for structures; disturbance or disruption to wildlife due to human activity associated with the facility; and the removal of grizzly bear, black bear or other animals attracted to food, refuse, or solid waste.

Impacts from the operations component would result in loss of wildlife habitat due to removal or covering of vegetation by stripping, making mine cuts, stockpiling, and building settling basins. Disturbance or disruption of wildlife would occur in the vicinity of the operation due to noise from machinery and other activities. There is the unpredictable possibility of spilling diesel fuel, a hazardous material, which would result in contamination and loss of vegetation.

ACCESS	FACILITIES	OPERATIONS
Direct (long term) habitat loss Disturbance (short term)/ disruption Increased (long term) harvest pressure Potential (long term) increased habitat loss	Direct (long term) habitat loss Disturbance (short term)/ disruption Removal (long term) of nuisance animals	Direct (long term) habitat loss Disturbance (short term)/ disruption Hazardous (long term) material spill

Figure 4-5. Potential impacts to wildlife from mineral development.

Potential mitigation measures for wildlife are presented in Appendix D-2 and Figure D-2(a) of this document. The type of mitigation or management control necessary to alleviate impacts to wildlife resources depends on the type, extent, and overall magnitude of the impact. Measures to avoid, minimize or rectify, and replace wildlife resources that may be impacted by mineral development are presented in Section 4.12, Figure 4-8, Appendix D-2, and Figure D-2a of this document.

4.6.1 Proposed Action

An additional 16.5 miles of permanent roads would remove approximately 100 acres of wildlife habitat. Permanent gravel roads directly associated with federal mineral development would total 41.7 miles (250 acres), and those directly associated with State and private mineral development would total 16 miles (97 acres). This includes 29.8 miles of existing federal access roads and 16 miles of existing State and private roads. These figures do not include the Steese and Elliott Highway and other primary roads. The level of vehicular use on roads and trails (excluding the Steese Highway, Elliott Highway, and other primary roads) would be low and minimal alteration, disturbance, or disruption of wildlife movement routes, and seasonal use areas is anticipated.

Improvement and expansion of access trails and roads into the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas would indirectly result in increased harvest of moose, caribou, grizzly bear, black bear, furbearers, and other species. Improving or establishing new access for mining, recreation, and other activities would indirectly facilitate more wildlife habitat loss and disturbance in wildlife use areas over the long term by enhancing the feasibility of mining more and larger areas.

The increased presence of 37 mining camp facilities and structures in the Minto Flats watershed would result in the long- term loss of 37 acres of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas. Facilities directly associated with federal mineral development would total 12 acres, those associated with State and private mineral development total 25 acres. Similarly, 666 acres of riparian habitat used by moose and other species would be unavailable for the short term due to frequent human disturbance from May through October. Disturbance at federal mineral development sites account for 216 acres, while

State and private activities comprise 450 acres of the total. The removal of grizzly or black bears as nuisance animals due to their attraction to food, refuse, or solid waste in the vicinity of mining facilities could occur.

Activities associated with stripping, mine cuts, stockpiles, and settling basins would result in physical alteration of about 4,853 total acres (pre-1981, 1987, and projected activity through 1998) of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas The habitat lost to mining operations associated with federal mineral development after 1987 would be 276 acres, and habitat losses associated with State and private operations would be 575 acres, for a total of 851 acres. Reclamation of federal mining areas would occur through leveling tailings, stockpiling and respreading overburden, and natural succession. Reclamation on State and private mining areas would generally consist of leveling tailings and natural succession (as described in Section 2.3). Revegetation in previously undisturbed federal mining areas would probably require 30 years, and revegetation in federal old tailing areas would require at least 50 years (Figure 4-3) to reach a stage suitable for moose browse. Revegetation in previously undisturbed State/private mining areas would require 50 years, and revegetation in State/Private old tailing areas would require at least 50 years (Figure 4-3) to reach a stage suitable for moose browse. Short-term avoidance by animals of 18,574 total acres of riparian and upland habitat during the summer mining season may occur in these areas due to noise from machinery and other mining activities. Areas subject to disturbance by noise from federal mining would be 6,024 acres, and disturbance from State and private mining would be 12,550 acres. The possibility of fuel spills exists and may result in contamination or loss of wildlife habitat.

Conclusion

The effects of the Proposed Action are summarized in Figure 4-6. Approximately 5,240 total acres of upland riparian wildlife habitat would be physically altered due to mining-related activities (including roads and facilities) in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas.

Periodic disturbances to wildlife due to use of roads and trails, operation of vehicles and machinery, and human habitation in the Minto Flats watershed totaling 56,670 acres could result in a low to moderate level of short-term adverse effects in localized areas, particularly during May through October. Minimum harvest of wildlife as a direct result of mining activities is anticipated in the Minto Flats watershed. The principal long-term adverse effect of new mining in the Minto Flats watershed would be the unavoidable loss (even with reclamation) of approximately 761 acres of the upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas for a 30-50 year period. In addition, approximately 651 acres of the area would remain permanently barren or support only sparse vegetation after 50 years. The long-term cumulative loss of habitat to federal (191 acres) and State/private (460 acres) mining activities in these areas may contribute to a slight reduction in moose population potential.

The potential exists for long-term cumulative adverse effects to moose, caribou, raptors, furbearers, or other species if human use of the area increases greatly in crucial wildlife habitats (i.e., caribou calving, caribou movement routes, nesting sites). Additionally, the potential exists for a greater long-term loss of wildlife habitat from removal of vegetation due to an increase in mining activity in crucial wildlife habitats. The long-term cumulative effects of potential future disturbance or disruption, and loss of habitat in crucial use areas, could be significant depending on the specific location, timing amount, and duration of the actions.

4.6.2 Alternative A

One additional mile of access road would be constructed in the Minto Flats drainages, removing approximately five more acres of wildlife habitat. Permanent gravel roads directly associated with federal mineral development would total 30.4 miles (184 acres), and those directly associated with State and private mineral development would total 11.7 miles (71 acres). The level of vehicular use on roads and trails (excluding the Steese Highway, Elliott Highway, and other primary roads) would be low and minimal alteration, disturbance, or disruption of wildlife movement routes, and seasonal use areas is anticipated.

Improvement and expansion of access trails and roads into the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas would indirectly result in increased harvest of moose, caribou, grizzly bear, black bear, furbearers, and other species. Improving or establishing new access for mining, recreation, and other activities would indirectly facilitate more wildlife habitat loss and disturbance in wildlife use areas over the long-term by enhancing the feasibility of mining more and larger areas.

The presence of 27 mining camp facilities and structures in the Minto Flats watershed would result in the long-term loss of 27 acres of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas. Facilities directly associated with federal mineral development would total nine acres, those associated with State and private mineral development total 18 acres. Similarly, 486 acres of riparian habitat used by moose and other species would be unavailable for the short term due to frequent human disturbance from May through October. Disturbance at federal mineral development sites account for 162 acres, while State and private activities comprise 324 acres of the total. The removal of grizzly or black bears as nuisance animals due to their attraction to food, refuse, or solid waste in the vicinity of mining facilities could occur.

Activities associated with stripping, mine cuts, stockpiles, and settling basins would result in physical alteration of about 4,605 total acres (pre-1981, 1987, and projected disturbances through 1998) of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas. The habitat lost to mining operations associated with federal mineral development after 1987 would be 207 acres, and habitat losses associated with State and private operations would total 414 acres for a total of 621 acres. Reclamation of federal mining areas would occur through leveling tailings, stockpiling and respreading overburden, and natural succession. Reclamation on State and private mining areas would generally consist of leveling tailings and natural succession (as described in Section 2.3). Revegetation in previously undisturbed federal mining areas would probably require 25-35 years, and revegetation in federal old tailing areas would require at least 50 years (Figure 4-3) to reach a stage suitable for moose browse. Revegetation in previously undisturbed State/private mining areas would require 25-35 years, and revegetation in State/Private old tailing areas would require at least 50 years (see Figure 4-3) to reach a stage suitable for moose browse. Short-term avoidance by animals of 13,554 total acres of riparian and upland habitat during the summer mining season may occur in these areas due to noise from machinery and other mining activities. Areas subject to disturbance by noise from federal mining would be 4,518 acres, and disturbance from State and private mining would be 9,036 acres. The possibility of fuel spills exists and may result in contamination or loss of wildlife habitat. **Conclusion**

The effects of Alternative A are summarized in Figure 4-6. Approximately 4,887 total acres of upland riparian wildlife habitat would be physically altered due to mining-related activities (including roads and facilities) in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas.

Periodic disturbances to wildlife due to use of roads and trails, operation of vehicles and machinery, and human habitation in the Minto Flats watershed totaling 41,486 acres could result in a low to moderate level of short-term adverse effects in localized areas, particularly during May through October. Minimum harvest of wildlife as a direct result of mining activities is anticipated in the Minto Flats watershed. The principal long-term adverse effect of new mining in the Minto Flats watershed would be the unavoidable loss (even with reclamation) of approximately 818 acres of the upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas for a 30-50 year period. In addition, approximately 365 acres of the area would remain permanently barren or support only sparse vegetation after 50 years. The long-term cumulative loss of habitat to federal (122 acres) and State/private (243 acres) mining activities in these areas may contribute to a slight reduction in moose population potential.

The potential exists for long-term cumulative adverse effects to moose, caribou, raptors, furbearers, or other species if human use of the area increases greatly in crucial wildlife habitats (i.e., caribou calving, caribou movement routes, nesting sites). Additionally, the potential exists for a greater long-term loss of wildlife habitat from removal of vegetation due to an increase in mining activity in crucial wildlife habitats. The long-term cumulative effects of potential future disturbance or disruption, and loss of habitat in crucial use areas, could be significant depending on the specific location, timing, amount, and duration of the actions.

Moose

4.6.3 Alternative B

Under this alternative, an additional 4.6 miles of State and private access roads would be constructed, with a corresponding loss of 28 acres of wildlife habitat. Permanent gravel roads directly associated with past federal mineral development totaling 29.8 miles (180 acres) would remain in place. Those roads directly associated with State and private mineral development would total 16 miles (97 acres). The existing roads and trails in the watershed would be used to access State and private mineral developments only if Alternative B is adopted. The level of vehicular use on roads and trails (excluding the Steese Highway, Elliott Highway, and other primary roads) would probably increase because of non-mineral development activities (recreation). No alteration of wildlife movement routes, disturbance, or disruption of seasonal use areas directly attributable to federal mining access would occur.

Recreation and other use of the access trails and roads into the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas would continue to indirectly result in increased harvest of moose, caribou, grizzly bear, black bear, furbearers, and other species. Improving or establishing new access for State and private mining activities may indirectly facilitate more wildlife habitat loss and disturbance in wildlife use areas over the long term by enhancing the feasibility of mining more and larger areas. Improving access or establishing new access for federal mining activities would not occur.

Facilities associated with federal mining camps in the Minto Flats watershed would be removed. Those facilities associated with State and private mineral development would result in long- term loss of 25 total acres of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas. Similarly, 576 acres of riparian habitat used by moose and other species would be unavailable for the short term due to frequent human disturbance during May through October at State and private mineral development sites. Federal sites would not operate and would be reclaimed. The potential exists for grizzly or black bears to be removed as nuisance animals because of their being attracted to food, refuse, or solid waste in the vicinity of State and private mining facilities only.

Past activities associated with stripping, mine cuts, stockpiles, and settling basins have resulted in physical alteration of approximately 4,002 total acres (pre-1981, 1987, and projected disturbances through 1998) of upland riparian habitat in the Upper Chatanika, Upper Goldstream/Cleary Summit and Upper Tolovana/Livengood areas. The habitat lost to mining operations associated with federal mineral development after 1987 would remain at 276 acres. Additional future habitat losses associated with State and private operations would total 575 acres. Reclamation of federal mining areas would consist of leveling tailings and respreading of available overburden. Reclamation on State and other mining areas would consist of leveling tailings and natural succession. Revegetation in federal mining areas would require approximately 40-50 years. Revegetation in previously undisturbed State and other mining areas would require 40-50 years, and revegetation in State/private old tailing areas would require at least 50 years (see Figure 4-3) to reach a stage suitable for moose browse. Short-term avoidance of 12,550 total acres of riparian habitat during the summer mining season would occur in State and private mine areas due to noise from machinery and other mining activities. Disturbance in the vicinity of federal mining claims would not occur. The possibility of fuel spills exists at the State and private mines and may result in contamination or loss of wildlife habitat.

Conclusion

The effects of the Alternative B are summarized in Figure 4-6. Approximately 4,602 total acres of upland riparian habitat would be physically altered because of mining-related activities (including roads and facilities) in the Upper Chatanika, Upper Goldstream/Cleary Summit, and Upper Tolovana/Livengood areas. New physical alteration of habitat associated with State and private operations would total 575 acres.

Periodic disturbances to wildlife from use of roads and trails, mining vehicles and machinery, and human habitation at State and private mines in the Minto Flats watershed would result in 42,814 acres being subject to minimal short-term adverse effects in localized areas during May through October. Additional disturbances from federal operations would cease. Recreation use of existing roads and trails and additional State and private roads and trails would indirectly facilitate increased harvest of wildlife in the area. The principle long-term adverse effect of past mining in the Minto Flats watershed would be the unavoidable loss (even with reclamation) of approximately 3,750 acres of upland riparian habitat for 40-50 years. Additional habitat losses in State and private mining areas (115 acres) would require approximately 50 years to become suitable for wildlife use. In addition, approximately 460 acres of the area would remain permanently barren or support only sparse vegetation after 50 years. The long-term cumulative loss of habitat to mining in this portion of the watershed may continue to contribute to a slight reduction in moose population potential.

The potential exists for long-term cumulative adverse effects to moose, caribou, raptors, furbearers, or other species if human use of the area increases greatly in crucial wildlife habitats. Additionally, the potential exists for a greater long-term loss of wildlife habitat from removal of vegetation due to a possible increase in State and private mining activity in crucial wildlife habitats. The long-term cumulative effects of potential future State and private mining disturbance or disruption, and loss of habitat in crucial use areas could be significant depending on the specific location, timing, amount, and duration of the State and private mineral development activities.

4.6.4 Special Considerations

Unavoidable Adverse Impacts

Unavoidable short-term impacts occur from mineral development. Species that are sensitive to noise, odors, movement, and the presence of human activity are most affected by mining activities and will avoid areas where these actions occur. Construction and use of facilities, operation of mining equipment, and increased vehicular traffic for access would be an unavoidable adverse effect to wildlife. Mining roads and trails are generally not removed or closed to present or future public use.

Action Component/ Potential Impact		Proposed Action	Alternative A	Alternative B
Permanent roads result in habitat loss	Extent	Federal: 41.7 miles/253 acres	30.4 miles/184 acres	29.8 miles/180 acres
		State/Private: 16.0 miles/97 acres	11.7 miles/71 acres	16.0 miles/97 acres
		Joint: 0/0	0/0	0/0
		Total: 57.7 miles/350acres	42.1 miles/255 acres	45.8 miles/277 acres
	Duration	Mine life & beyond	Mine life & beyond	Mine life & beyond
	Frequency	Annually	Annually	Annually
Use of roads/trails can disrupt normal wildlife use patterns;[2] increase access, increase harvest	Extent	Federal: 41.7 miles/27,190acres	30.4 miles/19,958 acres	29.8 miles/19,574 acres[1]
		State/Private: 16.0 miles/10,742 acres	11.7 miles/71 acres	16.0 miles/10,742 acres
		Joint: 0/0	0/0	0/0
		Total: 57.7 miles/37,430acres	42.1 miles/27,446 acres	45.8 miles/29,814 acres
	Duration	6 months (May–Oct) All months for recreation use	6 months (May–Oct) All months for recreation	Federal: NO EFFECT[1] State/Private: 6 months(May–Oct) all months for recreation use
	Frequency	Intermittent	Intermittent	Intermittent
Potential upgrading of roads/ trails & more roads/ trails can increase habitat loss, disturbance, & harvest	Extent	Federal: Unpredictable, but greater	Unpredictable, but greater	NO EFFECT[1]
		State/Private:Unpredictable,but greater	Unpredictable, but greater	Unpredictable, but greater
	Duration	Mine life & beyond All months for recreation use	Mine life & beyond All months for recreation	Federal: NO EFFECT[1] State/Private:Mine life & beyond, all months for recreation use
	Frequency	Annually	Annually	Annually
Gravel pads etc. remove/ cover habitat	Extent	Federal: 12 acres	9 acres	10 acres[4]
		State/Private: 25 acres	18 acres	25 acres
		Total: 37 acres	27 acres	25 acres
	Duration	Mine life plus 30–50 years	Mine life plus 25–50 years	Federal: 40–50 years State/Private: Mine life plus 40–50 years
	Frequency	Annually	Annually	Annually
Human habitation can cause disturbance/ disruption	Extent	Federal: 216 acres	162 acres	NO EFFECT
		State/Private: 450 acres	324 acres	450 acres
		Total: 666 acres	486 acres	450 acres
	Duration	6 months (May–Oct)	6 months (May–Oct)	Federal: NO EFFECT State/Private: 6 months (May–Oct)
	Frequency	Annually during mine life	Annually during mine life	Annually during mine life

continuation

Action Component/ Potential Impact		Proposed Action	Alternative A	Alternative B
Improper solid waste disposal may attract nuisance animals	Extent	Federal: 1–3 bears	1–3 bears	NO EFFECT
		State/Private: 1–3 bears	1–3 bears	1–3 bears
	Duration	6 months (May–Oct)	6 months (May–Oct)	Federal: NO EFFECT
				State/Private: 6 months (May–Oct)
	Frequency	Annually	Annually	Annually
Stripping, mine cuts, stockpiles & ponds remove/cover habitat	Extent	Federal: 276 acres	207 acres	0[4]
		State/Private: 575 acres	414 acres	575 acres
		Total: 2,595 acres[3]	2,365 acres[3]	2,319 acres[3]
	Duration	Federal: 30–50 years	25–50 years	40–50 years
		State/Private: 30–50 years	25–50 years	40–50 years
	Frequency	Annually	Annually	Annually
Operation of machinery can disrupt normal wildlife use patterns	Extent	Federal: 6,024 acres	4,518 acres	NO EFFECT
		State/Private: 12,550 acres	9,036 acres	12,550 acres
		Total: 18,574 acres	13,554 acres	12,550 acres
	Duration	6 months (May–Oct)	6 months (May–Oct)	Federal: NO EFFECT
				State/Private:
	Frequency	Annually	Annually	Annually
Hazardous material spills result in habitat loss	Extent	Federal: Unpredictable	Unpredictable	NO EFFECT
		State/Private: Unpredictable	Unpredictable	Unpredictable
	Duration	Federal: 30–50 years	25–50 years	NO EFFECT
		State/Private: 30–50 years	25–50 years	40–50 years
	Frequency	Unpredictable	Unpredictable	Unpredictable

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[1] Due to State/Private mineral development, recreation or other uses; none directly attributable to Federal mineral development.

[2] Maximum total area subjected to disturbance by use of roads/trails when/if wildlife are present.

[3] Includes pre – 1981 disturbance acreage.

[4] Reclamation will be conducted on areas presently disturbed with minimum available fines.

Figure 4–6. **Summary and comparison of probable effects on wildlife resources in relation to the proposed action and alternatives.**

This situation facilitates an increase in human use of wildlife and other resources over the long term. Over the long term, the extent, frequency, and duration of the activities determine the degree of disturbance or disruption.

Natural recovery of wildlife habitat is slow in areas that have been disturbed by mineral development. Reclamation practices can facilitate or enhance the recovery of wildlife habitat in disturbed areas; nevertheless, the affected habitat may be lost for 25 to 50 years. The principal habitats that are unavoidably lost over the long term for this time are the riparian habitats that are especially important to moose as winter range. Furthermore, previously-mined areas that are subjected to additional, new mining are the principle source of permanent habitat loss because fine material and other basic soil components are not available for use in reclamation. It is possible for localized extirpation or reduction beyond minimum viable population levels to occur if the overall extent of habitat loss is large and the duration is long term.

The potential for an overall increase in the level of cumulative impacts on wildlife and habitat exists. This could occur because of the accumulation of small, apparently insignificant, residual impacts to wildlife resources over time. This unavoidable impact could become substantial over the long term if conflicts between wildlife values, mineral development, increased visitor use, and a greater demand for human use of the wildlife resource are not adequately mitigated.

Short-Term Uses vs Long-Term Productivity

The long-term productivity of wildlife habitat subject to mineral development activities would depend on 1) the extent and timing of mineral development activities, 2) the success of mitigative measures or management controls to minimize the alteration and disturbance of normal wildlife use patterns, and 3) the successful reclamation of habitat that has been physically altered, removed, or lost.

Even the successful implementation of management controls to avoid, minimize, or replace lost habitat cannot prevent the possibility of a reduction in the long-term opportunity for increasing the potential moose population in the area. Specifically, the area has supported a larger population of moose in the past and the existing habitat has the potential to support a larger population. The present moose population is not at carrying capacity. The loss of existing moose habitat, especially late winter range, due to mineral development activities would reduce carrying capacity and could compromise the ADF&G management goal of increasing the moose population over the long term. The potential for optimal numbers of moose would be lowered because the habitat carrying capacity will have been reduced due to mineral development. The degree of impact to the moose population potential in the region due to mineral development would depend on the overall extent and duration of the habitat loss.

Irreversible and Irretrievable Commitments of Resources

Wildlife and habitat are renewable resources over the long term. If the mitigative measures designed to avoid, minimize, and monitor the adverse effects and to replace habitat physically altered by mineral development were fully and successfully employed, there would be little irreversible or irretrievable commitment or permanent loss of wildlife habitat over the long term. Previously-mined areas that are subjected to additional, new mining are the principle source of permanent habitat loss because fine material and other basic soil components are not available for use in reclamation.

4.6.7 Threatened & Endangered Wildlife

Impacts Common to All Alternatives

The Proposed Action and alternatives are anticipated to have no effect on the endangered peregrine falcon. Each operator is required to take such action as may be needed to prevent adverse impacts to threatened or endangered species, 43 CFR 3809.2-2(d).

The degree of impact on nesting activities and productivity of the peregrine falcon depends on the location, timing, extent, and frequency of disturbance.

Within the Minto Flats watershed there are conditions that could result in disturbance to the breeding falcons in the immediate vicinity of the eyries along the Minto Flats watershed. Persistent human activity has the potential to disturb breeding birds to the degree that they avoid localized areas or nest sites and may ultimately result in reduced productivity.

Protective Measures

Each proposal to conduct mining activities is evaluated by BLM on a case-by-case basis for potential conflicts with the peregrine falcon. As a result, the recommended protective measures of the Peregrine Falcon Recovery Plan (USFWS 1982), formal or informal consultation with the USFWS, may be employed by BLM, if necessary. The standard mitigation or protective measures recommended by the USFWS are:

A. **Within one mile of nest sites:**

1. Require aircraft to maintain minimum altitudes of 1500 feet above nest level from April 15 through August 31.

2. Prohibit all ground level activity from April 15 through August 31, except on existing thoroughfares.

3. Prohibit habitat alterations or the construction of permanent facilities.

B. **Within two miles of nest sites:**

1. Prohibit activities having high noise levels from April 15 through August 31.

2. Prohibit permanent facilities having high noise levels, sustained human activity, or which alter limited, high- quality habitat (e.g., ponds, lakes, wetlands, and riparian habitats).

C. **Within 15 miles of nest sites:**

1. Prohibit alteration of limited, high quality habitat which could detrimentally and significantly reduce prey availability. Of particular concern are ponds, lakes, wetlands, and riparian habitats.

2. Prohibit use of pesticides. The only exception may be limited non-aerial application of approved non-persistent insecticides at supply bases.

Additional Mitigation Measures

1) Limit or control the type of use, frequency, location, and noise from motorized equipment in critical habitat areas.

2) Direct the use of boats and campsites clear of critical wildlife use areas (raptor nest habitat) to minimize disturbance.

3) Limit or control number of people within the critical habitat to minimize disturbance.

4) Identify acceptable camp locations and locate at least one mile from nesting habitat to avoid disturbance.

5) Maintain coordination with USFWS.

6) Continue monitoring nesting habitat and use, as well as potential conflicts with motorized boats and campsites.

4.7 Fisheries

Placer mining may adversely affect aquatic systems directly through habitat disruption or physical alteration, and indirectly through point and non-point discharges of waste waters (Figure 4-7). Direct impacts to the aquatic community include the destruction of instream habitat, disruption of riparian zones, and creation of migration barriers. Indirect impacts to the aquatic community result from increased levels of trace metal contaminants, increased turbidity and suspended sediment, increased levels of settleable solids, increased imbeddedness of stream substrates, decreased food supply for fish, long-term changes in channel configuration, and long-term disruption of riparian habitats. The overall severity of these effects on aquatic communities depends on their magnitude, frequency, and duration.

	DIRECT EFFECTS	INDIRECT EFFECTS
Actions which physically alter the Aquatic Habitat	Loss of Instream Habitat	Straight\monotypic stream channel Increased water velocity Decreased pools
	Loss of Streamside (Riparian) Habitat	Unstable banks Decreased temperature control Decreased detrital nutrient input Decreased debris recruitment
	Creation of Migration Barriers	Decrease in suitable habitat
Discharge of Wastewater	Increased Suspended Sediment/Turbidity	Increase trace metals Decreased light penetration, which leads to decreased primary production Decreased incubation and rearing suitability for fish Decreased incubation and rearing suitability for aquatic insects Interference with fish migration, which leads to decreased available habitat Decreased opportunity for recreational fishing
	Increased Settleable Solids/Sediment	Decreased aquatic insect density, biomass, diversity which leads to decreased fish food supply Increased stream substrate imbeddedness Increased smothering of incubating eggs

Figure 4-7. Direct and indirect effects of physically altering the aquatic habitat and the discharging wastewater.

Effects on Aquatic Habitats

The increased total concentrations of trace metals below mining activity may pose a threat to aquatic animals if a significant portion of the total recoverable metals dissolve and are biologically available. There is a positive relationship between total recoverable and dissolved fractions of the metals. Therefore, it follows that reductions in sediment inputs from mining could substantially reduce metals concentrations in the affected streams (ADEC 1986, LaPerriere et al. 1985).

The biological significance of this conclusion is complicated by several factors. The sensitivities of arctic grayling and other organisms are not well known, the speciation of some of the metals is not known, the degree of tolerance of the local organisms is unquantified, and the proportion of metals that is biologically available versus that which is totally recoverable is unknown. All of these uncertainties contribute to the difficulty of assessing the biological significance of these data.

Increases in total suspended solids (TSS) levels in streams with placer mining and in receiving waters downstream are the most significant impacts of mining activity. Many studies document increases in suspended sediment concentrations of several orders of magnitude over background levels as a result of placer mining. The degree or magnitude of increase is highly variable and is a function of regional geology, type of mining operation, and effectiveness of waste water treatment.

Placer mining affects the physical habitat in a stream through destruction of the channel, and removal of the organic overburden of the banks and riparian zone adjacent to the stream. The post-mining stream channel is usually straight and the streams usually flow along bedrock with no pools, velocity barriers or other migratory blocks (e.g., settling pond dams).

The disruption of riparian habitat along the stream is a major impact from placer mining. This riparian habitat is important for bank stabilization, detrital nutrient input, temperature control, and debris recruitment. Weber and Post (1985) reported mined areas over 60 years old where riparian vegetation covered only 25% of the banks. As with reestablishment of the channel morphology, the regeneration of the riparian vegetation requires long periods in the subarctic environment. These processes can be expected to take in excess of 100 years on unreclaimed streams. These unavoidable impacts of placer mining on the aquatic system are typically long term, and may remain even with reclamation measures.

Effects on Aquatic Populations

Light penetration is crucial to primary production in aquatic ecosystems. Turbid conditions that reduce light penetration will reduce primary productivity. In turn, the effects of reductions in primary productivity are transmitted up the food chain and can ultimately result in reduced populations of fish and their prey organisms.

The general lack of streamside forest or canopy cover over some subarctic streams suggests that these streams may be highly dependent on instream productivity to support the higher lifeforms present in them. Reductions in primary productivity could lead to reductions in biomass of aquatic invertebrates and ultimately to reductions in fish biomass, at least in the higher elevation headwater areas. Destruction of the riparian vegetation along forested streams also reduces carbon inputs from leaf litter.

Sediment and/or turbidity adversely affect aquatic invertebrate density, biomass, and diversity. Studies demonstrate that increasing suspended and deposited sediment can lead to smothering and reduced respiratory efficiency of aquatic insects, abrasion, interference with filter feeders and net spinners, reduced food resources for grazers, cementing or increases in imbeddedness, and filling of crevices among larger cobbles. All of these actions result in habitat alterations that make the stream unsuitable for many species of aquatic organisms.

Weber and Post (1985) made comparisons of invertebrate populations above and below mining activity and compared unmined versus previously mined streams. In all cases, average densities of invertebrates decreased at sites below mining activity when compared to upstream controls. In many cases, whole families and one entire order (*Trichoptera*, caddis flies) disappeared below mining. In streams which had experienced previous mining activity, invertebrate densities were about 37% lower than unmined streams. In streams below active mining, invertebrate densities were reduced by nearly 90% compared with control stream segments.

The effects of reduced food supply and therefore reduced fat storage on overwinter survival and long-term fitness may be an important effect of placer mining on fish populations. It is possible that even if grayling were able to survive the summer in water heavily loaded with suspended sediments that they would be unable to store the same fat reserves accumulated by fish in clearwater areas. Therefore, they could be adversely affected in their overwinter survival, hampered in their upstream migration to spawning areas in the spring, and/or may be less able to produce viable gametes for successful reproduction. Overall, this could lead to a lower reproductive fitness of these fish populations and could lead to their possible elimination over time.

Numerous studies have been conducted to assess the effects of fine sediments on fish populations. Direct effects of suspended sediments on fish begin to be observed somewhere in the range of 50 to 100 mg/l (Herbert and Merkens 1961, EIFAC 1965, Noggle 1978, Berg 1982, McLeay et al. 1983, 1984, Simmons 1984, Lloyd 1985, Chapman and McLeod 1987, McLeay et al. 1987). EIFAC (1965) determined that no adverse effects of suspended sediments were demonstrated on fish at or below 25 mg/l. They further concluded that good to moderate fisheries could be expected with suspended sediment concentrations between 20 and 80 mg/l. At concentrations above 80 mg/l it was considered unlikely that good fisheries could be maintained, and at about 400 mg/l, only poor fisheries were to be expected.

McLeay et al. (1983, 1984, 1987) conducted an extensive series of experiments concerning the effects of sediments from placer mining on Arctic grayling. They found lethal and sublethal effects from acute exposure at concentrations of 50,000 to 250,000 mg/l and chronic exposure up to 1,000 mg/l. Chronic exposures for six weeks to concentrations greater than 100 mg/l impaired feeding, caused reductions in growth rates, showed changes in coloration, and caused downstream displacement of experimental fish. Stress, as measured by changes in blood chemistry, was reported in fish exposed for short periods to sediment concentrations as low as 50 mg/l. It was noted that downstream displacement and the resultant decrease in suitable habitat were of particular concern in maintaining healthy fish populations in streams exposed to placer mining.

Investigations have been conducted to determine the effects of placer mining on grayling distribution (Mathers et al. 1981, Weber and Post 1985, ADEC 1986). In two of these studies (Weber and Post 1985, ADEC 1986), fish were found in clear water tributaries of mined streams and in unmined streams but none were found in streams affected by mining. Mathers et al. (1981) found adult grayling in almost all streams they sampled but no juvenile fish were found in three streams heavily affected by mining. They found adult grayling in suspended sediment concentrations as high as 4,453 mg/l. However, they were unable to determine if these fish were residing in these conditions or were moving downstream to escape the high sediment loads. In one stream with suspended sediment concentrations over 7,000 mg/l, no grayling were found.

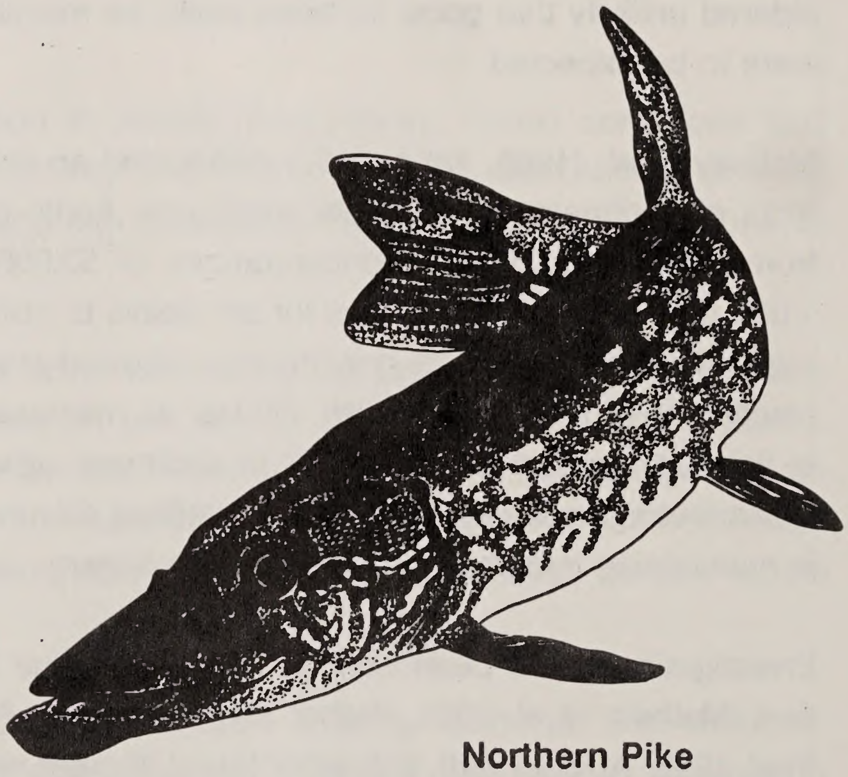
Sediment impacts to incubating eggs may have been the cause for the absence of grayling fry in three streams sampled by Mathers et al. (1981). Grayling broadcast their eggs over gravel or other substrates, making no effort to produce a redd as is common with trout and salmon (Reed 1964). Eggs exposed on the surface of the substrate are susceptible to smothering by sediment deposition from mining activities. This effect may have contributed to the apparent lack of spawning success noted by Mathers et al.

Physical disturbance of stream channels may be another factor that affected grayling distribution (ADEC 1986). Data suggest that long reaches of disturbed channels with potential passage barriers restrict migration into some clearwater tributaries and therefore affect access to available habitat in some river basins. This could adversely affect the ability of a basin affected by mining to support a grayling population.

4.7.1 Proposed Action

Concentrations of arsenic, copper, lead, or other trace metals would increase in areas below mining activities. The magnitude of the increase would depends on geology at mine sites, the type of mining operation, and the effectiveness of wastewater treatment. The biological significance of the increased metals concentrations is not known.

Mining operations of twelve placer mines on federal land would increase the total suspended sediment downstream from affected areas. The magnitude of impacts from increased suspended sediment and increased turbidity would depend on geology at the mine sites and effectiveness of wastewater treatment.


Northern Pike

Bjerklie and LaPerriere (1985) documented reduced hydraulic connection between surface and subsurface waters as an indirect effect of sediment on groundwater. The result of increased sediment in these circumstances is a lowering of the groundwater below the stream and a significant reduction in dissolved oxygen in mined streams. This condition could result in a reduction in overall quantity and quality of overwintering habitat and has been known to be directly harmful to fish eggs and aquatic insect larvae that may be present in the substrate materials.

The direct effects of mining operations would be habitat degradation due to physical alteration and possible blockage of fish migration. Streams in excavated areas develop new channels through the tailings and over exposed bedrock. These channels are usually shallow with few pools, have little instream cover, are unstable during breakup, and are generally poor habitat for fish and aquatic insects. These areas may also contain barriers to fish migration, resulting in the reduction of available habitat in upstream areas. The physical alteration at the mines would also result in the loss of riparian vegetation which, under normal conditions, provides bank stability, instream cover, temperature control, and detrital nutrient input.

Mining activities would reduce primary productivity in areas affected by increased suspended sediment and turbidity. The magnitude of reduction of primary productivity would depend on geology at the mine sites and effectiveness of wastewater treatment.

The average density (abundance) and diversity of aquatic insects would be decreased downstream of mining activities. The magnitude of the impact on aquatic insects would depend on total suspended sediment concentrations. These concentrations are, in turn, depend on of geology at the mine sites and the effectiveness of wastewater treatment.

Stream segments directly affected by mining operations are not expected to support arctic grayling or other species. However, clearwater tributaries and other areas in the basin would continue to support all age classes and sizes, including fry, of grayling and other species. The overall magnitude of adverse affect to fish populations is not possible to determine. The combined effect of the mining operations would at least partially eliminate grayling from the affected stream. The magnitude of the impacts to fish populations would probably depend on the extent of migration blockages due to physical barriers and/or sediment concentrations, and the extent of rearing habitat lost. Habitat suitability in the streams affected by mining would be adversely affected by increased toxic metals concentrations, reduced food supply, reduced cover and refuge habitat, and reduced visibility for feeding. Spawning habitat in unaffected streams is expected to provide some recruitment for the affected areas if they remain accessible to fish, and if the habitat is suitable for rearing.

Conclusions

Physical alteration and increases in suspended sediment in the basin would result in an adverse cumulative effect on the aquatic resources. Additional increases in sediment and turbidity are anticipated from new road construction within these drainages. If the streams are blocked to access for fish by the physical disturbances the total affected area would increase because of exclusion from clearwater areas upstream of mining activity. Some of the projected mining activity would probably be in areas previously dredged. Reclamation and stabilization of the bypass may improve fish habitat long term. The overall cumulative effect of total suspended sediment increases in Minto Flats cannot be determined. These effects would depend on geology at individual mine sites and effectiveness of wastewater treatment. The Tolovana and Chatanika Rivers would continue to support numerous fish species and key habitat, while the poor fish habitat and low fish populations would continue in parts of the upper Goldstream Creek drainage.

The duration of effects on aquatic resources would depend on the magnitude of habitat disruptions, the recovery of physical habitat, and recolonization by fish and aquatic insects. Aquatic invertebrate populations are expected to exhibit rapid recolonization because most of these organisms use an aerial adult stage (fly) for dispersion and propagation if there is suitable instream and streamside habitat present. Restoration of the river/stream channel to approximate natural conditions is the situation most suitable for recovery and recolonization of aquatic resources.

4.7.2 Alternative A

Impacts from mining under Alternative A would be reduced from those described in the Proposed Action due to minimum contribution of sediment and turbid process water to the stream and fewer projected mines. The reclamation standards would result in more rapid regrowth of the riparian vegetation (25-30 years), and reduce the amount of non-point sedimentation. The standards require rebuilding the stream channel in the original floodplain with pools, riffles, boulders, and approximately the original gradient. This replacement of habitat could minimize the long-term impacts to fish habitat. Remining of old dredged tailings could result in an opportunity to enhance fish habitat after reclamation of the current bypass. The reduction in impacts would probably be most notable in the Goldstream Creek drainage; however, the extent that fishery resources would recover is not known.

4.7.3 Alternative B

Physical alteration of stream segments and increases in suspended sediment from mining operations would result in unknown effects on aquatic resources. The principle streams directly affected by the State/private operations would be the Chatanika River and Goldstream Creek. The Tolovana River would be impacted the least by no mining on federal claims because there are few State and private mines projected in the drainage. The overall magnitude of the effects attributable to State/private mining cannot be determined. The magnitude of effects would depend on the geology at individual mine sites and effectiveness of wastewater treatment.

4.7.4 Special Considerations

Unavoidable Adverse Impacts

Placer mining results in unavoidable adverse affects on habitat, fish, and other aquatic life in areas of active mining. Effects on the downstream habitat from sediment increases on the channel and stream bed can result in changes detrimental to fish populations. Also, sport fish opportunities would be reduced because of increased turbidity in those stream sections below mining, but they would become available once the mining operation closes down and the site is successfully rehabilitated.

New mining in the headwater streams of Goldstream Creek and the Chatanika and Tolovana Rivers would increase land disturbances and increase turbidity from seasonal runoff. These new operations would produce increased sediment downstream from mining operations along with any ongoing mining activities. Channel changes, which destroy desirable fish habitat, in the vicinity of the disturbed areas could preclude fish uses.

Short-Term Uses vs Long-Term Productivity

The long-term productivity of fish habitat would depend on the extent and timing of the mining development, adherence to performance standards, success of reclamation efforts where the habitat has been physically altered, and level of mitigation required. Some short-term use that affects the long-term productivity are losses of desirable habitat and degradation of water quality from channel changes, increased channel gradients, degradation at the upper end of the mine disturbance, and sedimentation of stream substrate.

Occasionally, failure of water control structures, and runoff from access road construction and surface disturbance associated with mining will increase sediment discharge into the fish habitat. Also, introduction of sediment into the stream environment would occur during spring breakup and floods. Adherence to standards and mitigation measures would help alleviate these short-term problems.

Irreversible and Irretrievable Commitment of Resource

There would be no irreversible or irretrievable commitments of the fishery resources if mitigation measures are successfully followed and performance standards are adhered to.

4.8 Cultural Resources

4.8.1 Proposed Action

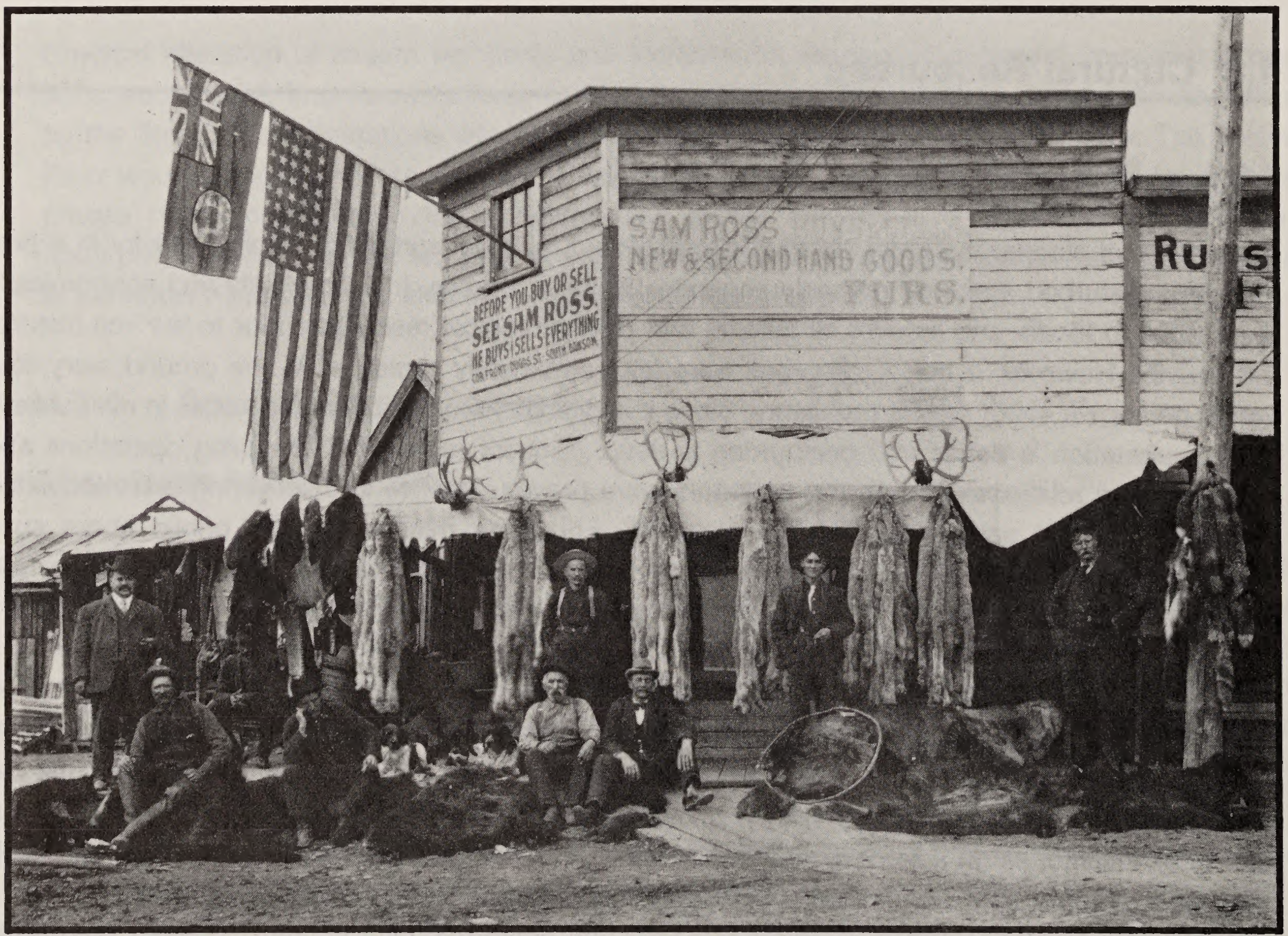
Regardless of standards set for differing alternatives, it is initial surface-disturbing activity in a previously undisturbed area that primarily impacts cultural resources. It is physically and economically impossible to locate and recover all cultural and paleontological resources prior to surface-disturbing activity. However, if these resources were left permanently protected in the ground, very little would be known about Alaska prehistory. Since it is difficult to locate these resources in river valleys where vegetation is dense and overburden is deep, frequent monitoring of mining operations and good working relationships with the operators have proven effective in discovering and recovering unearthed cultural and paleontological materials. Educating miners and the public about such resources, crediting the discoverer, and making research or analysis results generally available help protect cultural and paleontological resources and mitigate impacts.

All federal Notice and Plan operations are reviewed by a cultural resources specialist. A Class I Inventory, consisting of a check of literature sources and the Alaska Heritage Resources Survey (AHRS) files maintained by the State Historic Preservation Officer (SHPO), is conducted. This can constitute an "appropriate level inventory" under 43 CFR 3809. At the end of the season, a compilation of all inventories on actions is submitted to the SHPO as part of a Memorandum of Agreement approved by the ACHP. A paragraph describing the operator's responsibility for cultural resources is included in both Notice and Plan letters mailed to the operators. Information on known prehistoric, paleontological, or historic resources in the area and/or cultural resources potential is included in the case file. Most cabins and/or old mining structures and equipment are privately owned, part of the surface estate, or are not significant cultural resources. These are generally noted or documented during on-site compliance inspections, along with references to identified paleontological or prehistoric materials. When properly conducted by a cultural resources specialist, these on-site compliance inspections serve to monitor the continuing operation for cultural resources.

Should a site be discovered, a preliminary determination of significance is made for eligibility to the National Register of Historic Places by the BLM cultural resources specialist in consultation with the SHPO. Subsequent action may result in documentation, excavation, or avoidance of the site. A contradiction exists in the 36 CFR 800 regulatory timeframes which allow for comment by the SHPO and the ACHP on impacts and mitigation to significant sites, and timeframes for site removal in 43 CFR 3809. However, a situation that would address this has not yet arisen.

4.8.2 Alternative A

Assessment and examination for cultural resources would be the same as for the Proposed Action. Any change in impacts to cultural resources from choosing this alternative would be unlikely. As procedures would the same for cultural resources under all the alternatives, the differences in im-



Wares of the northern fur trade, circa 1908. From the "Toni" Troseth collection, courtesy of the Alaska and Polar Regions Department Archives, University of Alaska, Fairbanks.

pacts would necessarily be addressed in site-specific environmental analyses. This is because there are little baseline data on environmental characteristics. An analysis by a cultural resource specialist would provide a primary indication of cultural resources potential.

4.8.3 Alternative B

There would probably be little further impact to cultural resources under this "no mining" alternative. Previously undisturbed prehistoric sites and paleontological resources would remain unexposed, undamaged, and undiscovered. Historic mining sites, which are generally not protected by federal legislation, would remain largely intact although many old cabins, which are seasonally used and maintained by the miners, would be abandoned and subject to more rapid decay. Continuous natural erosion of drainages may damage and expose cultural and paleontological resources.

Mitigation Measures

Measures to mitigate impacts to cultural resources develop from environmental assessments prepared on Plans of operation, from Class I inventory work, and from previous examination of mining operations. The measures are described as stipulations in letters addressed to all operators with Plans, but are not repeated if they are the same measures needed to protect other resource values (e.g. only winter access over frozen ground with minimum snow cover will be permitted).

Frequent monitoring (on-site examination by a cultural resource specialist) on all operations is probably the most useful measure for identification and protection of potential resources. If a site or resource were found. the existing conflict between the regulations would arise, which would undoubtedly take time to resolve. Although avoidance of the resource is the preferred mitigation measure to protect or preserve a significant cultural site from impact, documentation is most commonly used to preserve a record of structures and equipment prior to their alteration or destruction. This is particularly important for historic mining sites which are not significant enough to merit NRHP eligibility and federal protection, but are of local historic interest. At a last resort, the site would be excavated, a very expensive and time-consuming undertaking that can conflict with the mining operation.

Unavoidable Adverse Impacts

Since no testing and little survey is undertaken prior to most surface-disturbing activity on mining operations, there is a possibility that cultural or paleontological resources are impacted or destroyed without the operators' or BLM's knowledge. Even if extensive testing and surveying took place prior to the operation, the potential for missing such resources is great due to heavy vegetation, large areas, and the depth of burial for most sites. Heavy equipment can and does destroy such resources, even without the operator being aware of the damage. Historic mining resources, which are not generally protected by federal legislation, can and have been destroyed.

Cumulative Impacts

Most of the mining in the Minto Flats drainage since 1981, and at present, is on previously disturbed ground in the heart of the lower drainages, and the potential for damaging undiscovered or previously undisturbed resources is insignificant. If the operations move higher up the valleys onto the bench claims and other undisturbed ground, the cumulative impacts may be significant. Not only would new ground be exposed, which would enable cultural specialists to examine "beneath the surface," but previously undisturbed cultural resources, historic mining sites, and paleontological material frozen in the overburden, which have barely been touched to date, could be adversely impacted.

Short-Term Uses vs Long-Term Productivity

Cultural and paleontological resources would be better preserved if no mining took place, but the knowledge from these discoveries would not be gained. However, it does not seem likely that continued operation with heavy equipment will result in much further discovery due to the destructive nature of such techniques. Constant monitoring of such operations may result in better discovery and recovery, but it could also slow mining operations. As long as the mining operations remain in the previously disturbed valley bottoms, the potential for significant new finds does not appear great enough, in view of the scarcity of resources found to date, to merit the expense and time required for extensive testing and constant monitoring.

Direct/Indirect Impacts

Direct impacts will be the actual destruction of sites, structures, or materials. Indirect impacts result from the increased accessibility of the area to people and the potential for damage to sites, structures, and materials from ORV's, hikers, and collectors.

Unavoidable and Irreversible Commitments of Resources

Cultural resources, both prehistoric and historic, and paleontological resources are finite and nonrenewable for any particular time period. Such resources, once damaged, are irretrievable; not only is the material possibly lost, but the scientific knowledge potentially gained from an undisturbed site is gone forever. This may include structures, soil stratigraphy, bones, pollen, and ash. The process of assessing and monitoring specific mining operations is much more important for protection of these resources than the choice of given alternatives.

4.9 Subsistence

Subsistence uses and needs may be affected to varying degrees by a variety of causes. In general, any action which disturbs the land, its vegetative cover, the quality or quantity of water resources, wildlife or fish populations, or human or animal access routes, may have an impact on subsistence uses and needs.

Such potentially impacting actions may occur all at once or gradually, so that the cumulative impact may build over time to increasingly affect subsistence. Further, cumulative impacts to subsistence uses and needs may occur strictly from human-caused events, or from naturally caused effects, or a combination of the two. When the latter is the case, it often becomes very difficult to quantify exactly how much of the cumulative impact is human-caused versus how much is caused by nature. Moreover, agreement on the exact percentage of human versus nature-caused impacts may be difficult to achieve due the the differing viewpoints or assumptions of people viewing the impacts. Also of potential dispute is how much impact seen today is the result of recent or ongoing events versus how much was caused by past events which, in some cases, could still be causing effects.

Placer mining is one human-caused impact in the Minto Flats area. In general, placer mining has the potential to impact subsistence uses and needs in the following ways:

1. Through a reduction in the potable water quality of a stream used as a source of drinking water.

2. Through disturbance or destruction of fisheries, animal populations, or habitats which support subsistence fishing, hunting, or trapping.

3. Through sedimentation of waterways which then impede human access to subsistence resources.

4. Through resulting increased harvest pressure due to the creation of more or better access routes into an area.

Other examples of human-caused potential impacts in the Minto Flats area include changes in hunting/trapping/fishing technology, changes in the numbers of people involved, or changes in the amount of harvest.

In the latter examples, the federal government, including BLM, may or may not have full or even any control over the impact. Also, fires may be human-caused, but their effects may be just as unpredictable as natural fires for destroying or improving wildlife habitat, populations, or causing sedimentation of streams. Further, developments may occur on private or State lands, beside federal lands, leading to new subsistence patterns or pressures. And the type or amount of subsistence resource harvest can vary due to decisions by the State of Alaska in regulating fish and game.

Other potential human-caused impacts to the Minto Flats area relate to the amount of enforcement of environmental laws by responsible State or federal agencies besides BLM (see further discussion in Chapter Two).

Finally, examples of potential nature-caused impacts to subsistence uses and needs in the Minto Flats area include natural stream changes, erosion and sedimentation, and natural permafrost degradation also resulting in sedimentation.

As noted in the subsistence section in Chapter Three, present village-based subsistence usage of the Minto Flats area is downstream from mining activity on BLM lands, and is done principally by residents of Minto village. As shown on the subsistence use area map, overall traditional subsistence use of the Minto Flats area by Minto village residents extends northeast to near Livengood, southward to beyond the Chatanika River, and then westward along the Tanana River to beyond its confluence with the Tolovana River. Thus, the past, current, or potential impacts to subsistence users and resources from mining are indirect to Minto village, and would involve events upstream from where village-based subsistence users usually go for harvesting resources at the present time.

ANILCA 810(a) Evaluation and Finding -- General Consideration

One of the purposes of an ANILCA 810 evaluation is to identify whether subsistence uses are being significantly restricted. Under the BLM definition of a "significant restriction to subsistence use" (see glossary), this level of restriction appears to have happened in the past, including during 1987 from mining activities or other causes. As noted in Chapter Three, decreases in the local availabilities of certain fish and wildlife have occurred. Further, there is evidence that certain customary riverine and lake navigational access routes in the Minto Flats area near Minto Creek village have been partially obstructed by sedimentation, including suspended solids that came from past upriver mining areas. Consequently, it would follow that a significant restriction to subsistence uses is occurring through 1987 in the Minto Flats area, with past and present mining involved in causing it to some greater of lesser degree.

Mining as it occurred in 1987, however, appears not to have notably further added to this ongoing condition of significant restriction to subsistence uses, though some sedimentation in the Minto Flats area did indeed result from 1987 mining (see Section 3.3, Soils).

Overall, some of the factors involved with this condition of significant restriction to subsistence uses include ones that occurred principally in the past and are unlikely to go away in the short-term of 5-10 years. For example, sedimentation of riverine and lake areas will remain a problem for water travel for many years into the future even if all mining ceased immediately in the Minto Flats area. Such cumulative impacts may be virtually permanent, from a short-term human use perspective. Also, sedimentation-related impacts on certain fish and wildlife and their habitats are unlikely to go away immediately even if all mining ended. Thus, while the forces of nature may flush out some now-sedimented areas over the long term (over 10 years), the corresponding potential recovery of fish and wildlife also would take time (see discussion under wildlife and aquatic fauna for further information). Finally, some degree of impact from mining to potable water in the various drainages associated with Minto Flats also could linger even if all mining ceased immediately because sediments related to past mining still would be washing downstream for some unknown period of time (see discussion under Section 4.4, Water Resources).

It is in light of all these complicating factors, plus the fact that most mining occurs on non-federal claims, that BLM must still do individual Section 810 (a) evaluations and findings on all alternatives presented in the EIS. Accordingly, it appears that the most reasonably approach is to focus each respective Section 810 (a) evaluation and finding for each alternative on how much, if any, new or increased contributions it would make in causing the downstream effects of:

1. Decreased fish or wildlife populations, including through increased access,

2. Decreased terrestrial or aquatic habitat,

3. Decreased access to subsistence resources, or

4. Any other water-related impacts, such as turbidity or deterioration of potential drinking water.

ANILCA Section 810 (a): Consideration of the Availability of Other Lands and Other Alternatives.

At the end of this environmental analysis process, BLM will have analyzed all and only the lands relevant to the purposes of this study, namely the lands involved in the Minto Flats area. Thus, this document is considering all relevant lands so that there are no "other lands" which could be considered. This includes consideration of impacts from mining on non-federal as well as federal claims. The Proposed Action and the two alternatives discussed in this EIS constitute the "other alternatives" required for consideration by ANILCA Section 810.

4.9.1 Proposed Action

As noted under the description in Chapter Two, the Proposed Action would continue management of mining for claims on federal land as it was conducted during the summer of 1987.

Past and Projected Future Cumulative Impacts

As stated earlier, there is an ongoing significant restriction to subsistence uses occurring in the Minto Flats area for the residents of Minto village due in part to the cumulative impacts from past mining. Present mining, itself, however, as it occurred in 1987 appears not to have notably added to these ongoing cumulative impacts.

As noted, one part of the ongoing significant restrictions to subsistence uses involves continuing (and increasing) problems of boat access to riverine and lake areas undergoing yearly sedimentation. The cause of this sedimentation, as discussed in Chapter Three, is only partly due to past mining, with other factors including lower water levels and possible geologic rebounding of the whole area also involved in impacting certain traditional boat access routes. As was stated in Section 3.1, Geology, the Minto Flats area presently serves as a natural sediment trap and will continue as such. Thus, while mining in the 1987 season did not notably add to the suspended solids entering the Minto Flats area, resuspension of sediments from past mining nonetheless may have occurred downstream from 1987 mining areas causing further sedimentation within the Flats. This probably took place at least within the Goldstream Creek system and is likely to continue. This means that old mining-caused sediments, even without any further mining, will continue washing down into the Minto Flats area. Such sediments will accumulate either temporarily or permanently, further changing certain drainage patterns, lake depths, and associated human access in the Flats. In the recent past, higher water levels may have in part masked this trend which became quite noticeable in 1987. Yet if similar lower water levels continue like in 1987 (which may be likely), the access-related problem for the people of Minto village may only worsen.

The other aspect to the condition of significant restriction of subsistence uses ongoing in the Minto Flats area for residents of Minto village is one involving certain decreases in the local availabilities of fish and wildlife. As noted under Section 3.7, Fisheries, baseline information is not sufficient to determine if or to what extent fishing resources in Minto Flats have been affected by sediment from placer mining (ADF&G 1987a). However, as noted also in the same section, it is possible that sedimentation from upstream areas of the Chatanika and Tolovana Rivers, and Goldstream Creek, may have damaged fish habitats in certain downstream unmined portions of those rivers. Thus, while the scientific proof of the harm by past mining to fish resources is not available, there is a likelihood that this has occurred based on the apparent harm to certain fish habitat that appears to have taken place. True or not, again, present mining as it occurred in 1987 on BLM mining claims appears not to have caused any notable fish habitat or population destruction. The situation for non-federal mining, however, is less clear as certain sedimentation did indeed come from those areas, particularly from the Goldstream Creek drainage into Minto Flats. Yet even that apparently is dwarfed by what occurred in the past. Shepherd (1987) states the following about today's level of sedimentation compared to the past:

> "Estimates of the amounts of hydraulic muck carried by the Chatanika River and the Goldstream Creek are not available. Wolff (1985) believes the figure may exceed 100 million wet cubic yards, of which most was transported by Goldstream Creek. This amount of muck would fill a two square mile area to a depth of 50 feet. The present silt levels of suspended solids resulting from placer mining production and carried by the Chatanika River, Tolovana River, and Goldstream Creek, are not comparable with those derived from past hydraulic removal of overburden. Recent studies by Weber and Robus (1987), Mack et al. (1987), and Townsend (1987) provide data suggesting that turbidity levels of Minto Lake, Tolovana River and Chatanika River are near or below acceptable levels. Data provided by Weber and Robus (1987) reveal only trace amounts of settleable solids reaching Minto Lake via Goldstream waters."

Concerning terrestrial animals, moose populations are low in the Minto Flats area as noted under Section 3.6, Wildlife. Yet, this is not due notably, if at all, to mining in the upstream areas from Minto Flats. Heavy winter losses in the 1960's and early 1970's, plus increased hunting, generally appear to be the main factors. Also, the increase of wolves may contribute, especially as the Minto Flats area becomes dryer, thereby giving wolves an increased ability to enter moose-rearing areas previously protected by higher water levels.

Water is important to the subsistence lifestyle of rural Alaskans. Photo courtesy of BLM Public Affairs.

As observed by Minto residents, sedimentation of certain river bank and lake shore areas may have impacted certain local furbearer habitats, but no scientific studies can be cited to confirm this. What seems to be certain, however, is that a continuing natural drop in water levels like in 1987 can only further complicate attempts to sort out causes for this possible problem. Yet, even in 1987, there is no general decline in furbearers in the Minto Flats area. While past hard winters, as noted, apparently were responsible for the declines in muskrats, in contrast recent beaver and marten populations are high. In any case, the possible impacts to wildlife related to mining would be tied to past mining, if at all, and not notably from the mining that occurred in 1987.

On balance, this type of management, like in 1987, would serve to substantially lessen the amount of suspended sediments coming from federal mining claim areas, but it would do absolutely nothing about potential suspended sediments entering the Minto Flats area from mining or eroding areas on State or private lands. BLM has no control over those areas which contain about two-thirds of the ongoing and likely future mining operations.

Thus, regardless of how little suspended sediment might come from federal mining claims within the Minto Flats area under the Proposed Action enough is still likely to come off non-federal areas to continue causing significant restrictions to subsistence uses downstream. This is true if no mining were to occur on any federal claims, or if mining were to occur on all federal claims. The only difference would be that with more mines operating on federal claims, the amount of discharged suspended sediments (relatively small amounts) generally would increase correspondingly (see further analysis under Section 4.4, Water Resources). What this all means for downstream subsistence uses and resources is a continuation of the present state of a cumulative significant restriction, most notably caused by no reclamation requirements at non-federal mines and ongoing sediment redeposition.

Another possible issue of concern related to subsistence is the effect of flocculants on the quality of drinking water. During 1987, only two operations were known to have tried adding flocculants to their settling ponds, with only one (on Faith Creek, a tributary of the Chatanika River) utilizing them for most of the season. Thus, it is assumed that few flocculants potentially entered Minto Flats in 1987 and that any apparent decreases in water quality were not due to that cause (see further discussion under Section 3.4, Water Resources).

Finally, the cumulative effects on Minto Flats due to increased mining-related access is seen as insignificant. Much more important is that recreationists and others can enter the Minto Flats area quite easily from the existing highway and new access routes unrelated to mining. Thus, Minto Flats, lying so close to Fairbanks, likely will continue to be much more impacted from people coming directly into the Flats than by those using more distant mining access roads.

Compliance with Section 810 (a) of ANILCA; Evaluation and Finding

1. Uses and Needs. As discussed above and elsewhere, the Proposed Action is to have mining occur on federal claims in such a way that relatively little impact would result to water quality in the Minto Flats area. As a consequence, mining in these federal claim areas would not itself be the major potential source for causing continuing significant cumulative impacts to subsistence uses and resources. The more significant causes would be: 1) potential impacts from non-BLM controlled mining (due to no reclamation standards) or other erodible areas on non-federal lands, and 2) old sediments from past mining continuing to be resuspended by streams flowing into Minto Flats for deposition there. As stated before, this latter phenomenon is a cumulative impact that will continue for several years even if all mining ceased immediately in the Minto Flats area. In all, while the water quality downstream from mining operations on federal claims would continue to be better as in 1987 under the Proposed Action, this will do nothing to reverse the cumulative significant impacts affecting downstream subsistence uses and resources.

2. Section 810 (a) Finding for the Proposed Action. The Proposed Action would not reverse the condition of an ongoing significant restriction to subsistence uses occurring in the Minto Flats area despite its not being the primary cause. Thus, under the Proposed Action a significant restriction to subsistence uses would still result. The direct reasons for this finding are given in the preceding sections with supporting information found in other sections analyzing the impacts to fish, wildlife, water, and soils for this alternative.

4.9.2 Alternative A

Alternative A would be different from the Proposed Action. The main differences are that water quality performance standards are more stringent for both federal and non-federal mining operation and that restoration would be enhanced (although actual reclamation standards remain similar to those under the Proposed Action). An even more dramatic difference is that the assumption made under this alternative is that all other mining on non-federal claims on streams draining into the Minto Flats area would meet reclamation as well as water quality standards for mining on federal claims. If this were to occur, the likely downstream negative effects on subsistence resources and users from water quality factors (including sedimentation) would lessen with each passing year. However, as explained, a significant restriction to subsistence uses would still remain in the Minto Flats area until the past cumulative effects of sedimentation are substantially reversed -- something that would take years to occur. In other words, the trend to reverse the condition of significant restriction to subsistence uses would be established, but it would be years before it actually reversed. Thus, from a short-term (5-10 year) perspective, the impacts on subsistence uses and resources are likely to be similar to those under the Proposed Action. Therefore, the impact analysis statements concerning subsistence for the Proposed Action apply to Alternative A and should be read for further information.

Compliance with Section 810 (a) of ANILCA: Evaluation and Finding

1. **Uses and Needs.** The statements made under this heading for the Proposed Action completely apply to Alternative A because the net effects on subsistence uses and needs are the same.

2. **Section 810 (a) Finding for Alternative A** Alternative A would not reverse the condition of an ongoing significant restriction to subsistence uses occurring in the Minto Flats area despite its not being the primary cause. Thus, under Alternative A, a significant restriction to subsistence uses would still result. The direct reasons for this finding are given in the preceding sections (which refer back to the Proposed Action analyses), with supporting information found in other sections analyzing the impacts to fish and wildlife, water, and soils for this alternative.

4.9.3 Alternative B

As indicated under the description of this alternative, no mining would occur on federal mining claims although stabilization of surface disturbances that have occurred since 1980 would be required. Further restoration of past mined areas on federal claims would proceed only by natural causes. A significant level of mining, however, potentially would still occur in the Minto Flats area but only on State and private claims not under BLM jurisdiction. The net result of this for subsistence uses, users, and resources would be virtually the same as for the Proposed Action.

As for the possibility of any impacts occurring from federal mining claim areas, conceivably natural erosion during spring runoff or at other times of high water could cause some additional turbidity in streams entering Minto Flats from areas where further restoration would not take place. Still, as discussed in the water and aquatic fauna impacts assessment sections for this alternative, the resulting downstream effects, even if this were to happen, are predicted to be negligible. They would not contribute appreciably to the accumulation of impacts otherwise occurring from non-federal mining or from past mining in the drainage. Otherwise, the likely downstream effects on subsistence resources and users from non-federal mining areas would be no different than under the Proposed Action. Thus, information stated there applies to Alternative B and should be read.

Compliance with Section 810 (a) of ANILCA: Evaluation and Finding

1. Uses and Needs. Despite the fact that no mining would occur on federal lands under Alternative B, much of the same reasoning given under this heading for the Proposed Action still applies to this alternative because the overall net effect is similar on subsistence uses and needs -- there would still be significant impacts otherwise in the area.

2. Section 810 (a) Finding for Alternative B. Alternative B would not reverse the condition of an ongoing significant restriction to subsistence uses occurring in the Minto Flats area despite its not being the primary cause. Thus, under Alternative B, a significant restriction to subsistence uses would still result. The direct reasons for this finding are given in the preceding sections (which refer back to the Proposed Action analyses), with supporting information found in other sections analyzing the impacts to fish and wildlife, water, and soils for this alternative.

Summary of ANILCA Section 810 (a) Findings

The findings for all alternatives, including the Proposed Action, were the same; namely, none would reverse the condition of an ongoing significant restriction to subsistence uses occurring in the Minto Flats area, although none would be significantly responsible for its continuation. Thus, under the Proposed Action or any alternative, a significant restriction to subsistence uses would still result even with no mining occurring on any federal mining claims whatsoever. This is because the predicted contributions of impacts to subsistence uses, users, and resources from federal claims under the Proposed Action and both alternatives were evaluated to be negligible in the larger equation of what is causing the ongoing significant restriction or what would cause it in the future. This conclusion was reached because only negligible effects were predicted from any of the alternatives (including the Proposed Action) on animal populations, habitat, human access, or general water quality of Minto Flats. Overall, the most beneficial alternative to lessening the ongoing restrictions to subsistence uses and resources would be Alternative A. That is because only under Alternative A are non-federal lands disturbed by mining required to be reclaimed, with these lands representing the majority of those being mined in the Minto Flats area.

Finally, it should be noted that in arriving at these evaluations and findings, potential immediate, future, and cumulative impacts were considered, with the reader referred back to the respective impact analyses sections for details on each alternative.

4.9.4 Special Considerations

Recommended Mitigation Measures

Because no notable cumulative impacts to subsistence uses and needs are foreseen to result from future mining on federal mining claims under the Proposed Action and both alternatives, no new special mitigation measures are recommended. See preceding sections supporting this conclusion.

Unavoidable Adverse Impacts

No notable cumulative unavoidable adverse impacts are likely to occur under the Proposed Action and both alternatives from federal mining claim areas to downstream regions utilized for subsistence purposes by residents of Minto village. The only potential adverse impacts would be the relatively low levels of suspended sediments which would enter waters draining into Minto Flats off federal lands thereby adding somewhat (arguably not significantly) to the other sediments from non-federal land sources. See preceding section supporting this conclusion.

Irreversible and Irretrievable Impacts

Also, no further irreversible and irretrievable impacts are likely to occur from federal mining claims under the Proposed Action and both alternatives to downstream areas important to village-based subsistence users for reasons again given in preceding sections. Of note, however, is the fact that certain possibly irreversible and irretrievable impacts may have already occurred regarding sedimentation filling in low areas, such as Minto Lake. Mining on federal claims should not notably add to this sedimentation, which otherwise could continue from non- federal sources and past events, as noted earlier.

Short-Term Uses vs Long-Term Productivity

The Proposed Action and Alternative B should have no notable impacts to further cause either long-term or short-term productivity changes in the availability of wild, renewable resources used for subsistence purposes by residents of the Minto Flats area. Again see preceding sections supporting this conclusion.

As explained previously, under Alternative A, the impacts to water quality from all mining in the Minto Flats area generally would lessen over time. This means that in the short term (5-10 years), those negative effects on fish and wildlife species caused by water quality would progressively decrease, although the total fish and wildlife populations may continue to be negatively impacted by all the other non-mining factors explained earlier like low water, more wolves, harvest pressures, and so forth. Yet in the short term, the sedimentation of certain riverine and lake areas would continue to occur, although probably at a decreased rate. This is even if all mining in the entire Minto Flats area met water quality standards for Alternative A, or ceased altogether, as explained earlier. Thus, some short-term fish and wildlife productivity gains might occur even though short-term negative impacts from sedimentation would continue. In the long term (more than 10 years), natural river actions may help decease a certain amount of further deposition of old sedimentation loads in the Minto Flats area by flushing them out into the Tanana River for further transport downstream. Yet, other sediment will still remain in the area and add to areas already impacted.

4.10 Recreation and Visual Resources

The degree of impact to recreation and visual resources values resulting from mining-related activities depends on the location, duration, timing, and frequency or extent of the activity. Additionally, the impacts to the recreation and visual resources for all alternatives directly depend on the impacts of placer mining to Water Resources (Section 4.4), Landcover (Section 4.5), Wildlife (Section 4.6), and Fisheries (Section 4.7).

The entire Minto drainage, except some federal mining claims, lies within the political and administrative jurisdiction of the State of Alaska and private landowners. These landowners do not have any recognized recreation management plans for these areas; therefore, potential recreation and visual impacts are limited.

As the Dames and Moore recreation survey (ADEC 1986b) indicated (See Figure 3-8, Section 3.10), household use has been very limited, and State Parks data indicate a modest visitor count at the Upper and Lower Chatanika State recreation areas. It is apparent that visitor use improves as the water quality improves, but there is no documented correlation between visitor use and water quality.

Potential Impacts to Recreation From Mineral Development

Access

Access roads and trails will diminish the perception of the pristine landscape by recreationists. Increased access may reduce the wildlife viewing opportunities, but may also open up new areas.

Improved access would increase recreational activities resulting in more hunters over an increased area, more recreational users of rivers, and more campers and hikers. More recreationists could see more of the area because of increased viewshed accessibility. Improvement and expansion of access trails and roads may indirectly increase harvest of game.

Facilities

Facilities located on gravel bars or below the mean high water line diminish the quality of recreation activities. Long-term camping would be generally unregulated on State lands and could create short-term visual impacts as well as water and health problems due to disposal of chemicals and sewage.

Operations

Wildlife viewing and hunting may be disturbed by noise and reduced water quality produced by operations such as waste water discharging. Boating and rafting would be disturbed by river channel relocation. Reduced water quality (turbidity and reduction of potable water) also would reduce recreational dredging as well as other river-oriented recreational activities. Noise would reduce both the enjoyment of recreational experiences and the amount of wildlife.

There is a possibility of environmental degradation from fuel spills and long-term habitat loss on gravel pads, stockpiles, mine cuts, settling basins, unreclaimed areas, and areas of past mining activity.

4.10.1 Proposed Action

Recreation Resources

Hiking, sightseeing, camping, and hunting activity may increase due to increased emphasis on statewide tourism. Anticipated impacts to fish and wildlife habitat and populations may affect the quality of hunting, fishing, and wildlife viewing opportunities. Anticipated impacts to the water resources also would directly affect the quality of the recreation opportunities which can be maintained for the public. The overall impact on the recreation values could result in their further degradation relative to recreation management objectives.

Visual Resource Management

Additional access roads and mining activities would be authorized, which would create additional impacts on the visual resource. There is already an impact by those activities which have removed the vegetative cover, exposed the soil, and altered the characteristic landscape. Increased access would allow more people into the area and increase recreational use of the river. Such an increase would probably require additional facilities and use supervision, and thus decrease the primitive nature of the areas, while increasing management costs. Increased road construction and mining activities would further impact water quality. Meeting water quality standards would have a positive effect on the visual resource by changing the way people perceive the landscape. Low water quality diminishes the perception of a wild and natural landscape by river recreationists and others.

Rafting, Fishing, and Sightseeing

The increased mining would cause additional disturbance of the river bottom, banks, and terraces in the immediate area of mining activity. This would decrease the perception of a wild landscape unaffected by humans, and increase the contrast of the landscape by adding areas of bare soil and gravel. This disturbance may continue for 30-50 years after cessation of mining on a location, but would then reestablish to a shrub and young deciduous community in most areas. Some of the mined areas would remain barren, but would be in a mosaic, responding to the influences of mining practices and environmental parameters.

Assessment and evaluation for visual resources on federal claims would be conducted on a case-by-case basis. Individual management actions, whether proposed by the mineral claimant or by the federal government, would undergo a visual resource assessment. Evaluating proposals on a case-by-case basis promotes effective visual resource management of the public lands.

4.10.2 Alternative A

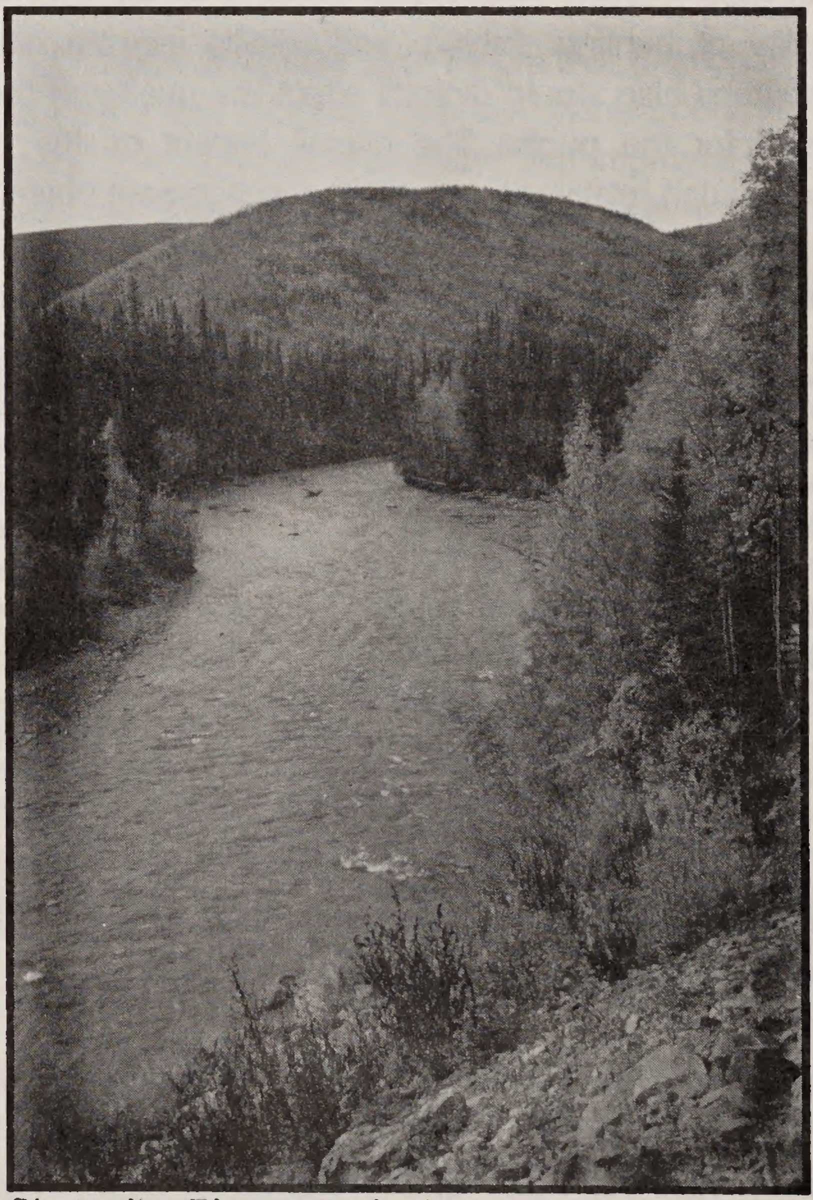
Recreation Resources

Anticipated impacts to fish and wildlife habitat and populations may affect the quality of hunting, fishing, and wildlife viewing opportunities, though less so than for the Proposed Action. Anticipated impacts to the water resources also would directly affect the quality of the recreation opportunities. Improvement in the water quality would improve those recreation values related to water resources.

The major impact to recreation would be the improved water quality due to mines meeting effluent standards. This may result in increased water-based recreation.

Travelers along roads, with attendant camping, sightseeing, and hiking would probably increase.

Impacts to recreation would be less than those under the Proposed Action. The improvement of water quality, and post-mining reclamation would reduce the impact of current mining activities on recreationists using the area. There should be increased river use by floaters. Camping, hiking, hunting, sightseeing, and other off-road activities may increase.



Chatanika River near its headwaters.

Visual Resources

The impacts of placer mining on the visual resources are expected to be less than the Proposed Action. This alternative would provide for the least visual impacts. Water quality would be good to excellent, giving the impression of a scenic river to floaters, hikers, and other viewers. Reclamation would reduce the long-term impacts of mining activities. Vegetation would become reestablished within 25-30 years, reducing the duration of the impact of barren areas.

4.10.3 Alternative B

Recreation Resources

Some mines would operate in the watershed. Impacts to recreation would be moderate, with some improvement in water quality as compared with the Proposed Action. As many of these operations would be in or near the river itself, recreational floaters may avoid the mined streams and move into unmined drainages. Road-based and off-road recreation would continue at current or increased levels.

State and private mining would continue and there would be no reclamation on these lands. Some impacts would continue from federal mining areas due to reclamation of tailings, existing roads, and disturbed areas undergoing reclamation. Therefore, the semi-primitive recreation experience may not be attainable in some drainages.

Visual Resources

Impacts would continue on State and private lands. By ending all mining activity on federal lands, the introduction of new visual intrusions would also be stopped. Some visual impacts from past mining may, remain as long-term impacts.

4.10.4 Special Considerations

Unavoidable Adverse Impacts

The cumulative impacts of mineral development in the Minto Flats watershed on the recreation and visual resources is directly dependent on the cumulative impacts expressed in Water Resources, Wildlife, Fisheries, and Landcover. These resources are integral components of the recreation opportunities provided. The quality of these resources affects the quality of the recreation activity experienced, and recreation management prescriptions are directly related to these resource values.

Unavoidable short-term impacts occur from mineral development. Visitors to the Minto Flats watershed in areas adjacent to mineral access routes, facilities, or operations would not experience pristine or semi-primitive recreation opportunities. Visitors seeking hunting, fishing, or wildlife viewing may also have somewhat less of a primitive recreation experience where concentrations of mining operations occur. Federal, State, and private mining operations contribute to the turbidity of the rivers and adversely affect visitors seeking a pristine setting.

Short-term Use vs Long-Term Productivity

It is expected that the short-term use of resources for active placer mining would compromise certain recreation values, such as primitive areas. At the same time, long-term productivity may continue to be affected by placer operations if adequate and appropriate reclamation is implemented. Roads would continue to constitute a long-term impact, because they traditionally remain in use and are not reclaimed, with concomitant impacts on other recreational and visual values.

Irreversible and Irretrievable Commitment of Resources

Placer mining, suction dredging, and associated activities do constitute an irreversible and irretrievable commitment of certain resources. With appropriate reclamation, enforcement of applicable State and federal statutes and standards, and appropriate mitigation measures, recreation and visual values need not be irreversibly committed beyond the present situation.

4.11 Economics

4.11.1 Proposed Action

With a continuation of present management, it is assumed that the total number of mines within the watershed would increase from 30 to 37 (23%) over the next decade. If so, it is reasonable to also assume that mining expenditures, total output, mining employment, employment effect, mining income, and total income would also increase by about 23%.

Local population associated with placer mining in and around the Minto Flats would be expected to increase about by 40 people. This is based on the assumption that 29% (Hagler, Bailly, and Co. 1987) of the additional miners would reside within the drainage or in nearby communities, and that the population would increase by three individuals for each additional miner.

Economic impacts are displayed in Figure 4-8.

4.11.2 Alternative A

With Alternative A, it is assumed that the total number of mines within the watershed would decrease from 30 to 27 (10%) over the next decade. If so, it is reasonable to also assume that mining expenditures, total output, mining employment, employment effect, mining income, and total income would also decrease by about 10%. This would cause an unavoidable adverse economic impact that would be most apparent in the communities of the Minto Flats drainages. Total employment and income would change by less than 1% from the 1985 levels for the Fairbanks North Star Borough.

Local population would be expected to decrease by about 10 to 20 people, assuming that 29% of the unemployed miners lived in the drainages or in nearby communities, and the population would decrease by three individuals for each unemployed miner that moves away.

	1985 level	Proposed action	Alternative A	Alternative B	Worst Case Scenario
Total Number of Mines	30	37	27	25	270
Percentage change from 1985		+23%	-10%	-17%	+800%
MINING EXPENDITURES[1]					
Rural Alaska	$1,540,000	$1,894.000	$1,386,000	$1.278,000	$13,860,000
Fairbanks	$8,233,000	$10,127,000	$7,410.000	$6,833,000	$74,097.000
Alaska	$11,837,000	$14,560.000	$10,653,000	$9,824,000	$106,533,000
TOTAL OUTPUT[2]					
Fairbanks	$13,535,000	$16,648,000	$12,182,000	$11,234,000	$121,815,000
Alaska	$22,812,000	$28,059,000	$20,531,000	$18,934,000	$205,308,000
MINING EMPLOYMENT					
Rural (within the drainage)[3]	203	250	183	168	1,827
EMPLOYMENT EFFECT[4]					
Fairbanks	190	234	171	158	1,710
Alaska	339	417	305	281	3,051
MINING INCOME[1]					
Rural Alaska	$1,029,000	$1,266,000	$926.000	$854.000	$9,261,000
Fairbanks	$1,263,000	$1.553.000	$1,137,000	$1.048.000	$11.367,000
Alaska	$2,430,000	$2,989,000	$2,187,000	$2,017,000	$21,870,000
TOTAL INCOME[5]					
Rural Alaska	$2,614,000	$3,215,000	$2,353,000	$2,170,000	$23,526,000
Fairbanks	$2,703,000	$3.325,000	$2,433,000	$2,243,000	$24,327,000
Alaska	$6,172,000	$7,592,000	$5,555,000	$5,123,000	$55,548,000

[1] Minto Flats Mining Expenditures taken from Hagler, Bailly & Co. 1987, Table 10.

[2] Taken from Hagler, Bailly & Co. 1987, Table 11.

[3] Taken from Hagler, Bailly & Co. 1987, pg. 3.18.

[4] Direct plus indirect employment generated by mining in the Minto Flats drainage - taken from Hagler, Bailly & Co., 1987, Table 11.

[5] Total Income = Wage & Salary Expenditures X appropriate income multiplier from Chap. 3.

Figure 4-8. Minto Flats Economic Impacts.

4.11.3 Alternative B

With Alternative B, it is assumed that the total number of mines within the watershed would decrease from 30 to 25 (17%) over the next decade. If so, it is reasonable to also assume that mining expenditures, total output, mining employment, employment effect, mining income, and total income would also decrease by about 17%. This too would cause an unavoidable adverse economic impact. Under this alternative, total employment and income within the Fairbanks North Star Borough would change by less than 1% from the 1985 level.

Local population in the Minto Flats drainages would be expected to decrease by about 30 people, assuming that 29% of the unemployed miners would reside within the drainage or in nearby communities, and the population would decrease by three individuals for each unemployed miner that moves away.

4.12 Mitigation

Mitigation measures are generalized prescribed actions which can be taken to reduce or eliminate the impact of placer mining on various resources in the Minto Flats watershed.

Guidelines for development of measures to mitigate impacts to resources included prioritization of the types of mitigation. The highest priority is to avoid the impact, a lesser priority is to minimize or rectify the impacts, and the last priority was to replace the impacted resource. On-site or in-basin mitigation within the stream or drainage where the impact occurred is favored, as is "in-kind" mitigation, where the impacted resources would be replaced, thereby reducing both potential disruptions to the system's ecology and management problems. Some impacts cannot be mitigated and are an irreversible or irretrievable impact to the resource.

When specific mineral development actions are proposed in the area, a site-specific analysis of effects will be developed through the environmental assessment process for each Plan of Operations, as required by the NEPA and 43 CFR 3809. As a result of this process, stipulations which alter or restrict timing, location, and extent of a mineral development activity may be required to avoid or minimize adverse effects and to avoid unnecessary or undue degradation. Various mitigation measures are shown in Figure 4-9 and are discussed extensively in "Surface Disturbing Activities in Alaska: A Guide to the Technical Aspects of Mitigation and Reclamation" (DOI 1987d). Recommended mitigation measures for wildlife resources and accompanying rationale are in Appendix D-2.

The alternatives are a gradient of mitigation measures, with emphasis on water quality and reclamation standards (Section 2.3). The effectiveness of the mitigation measures will vary considerably with the site conditions of each mining operation. The varying degrees and effectiveness of the reclamation efforts required by the Proposed Action and each alternative have been incorporated into the analysis and are discussed in their respective sections.

In order to provide an appropriate level of mitigation for any impact, the extent and magnitude of the impact's effects on the resource must be known. In some cases, impacts cannot be precisely estimated due to their complexity, the lack of information, or the low probability of their occurrence. Additional information is then required to develop suitable mitigation. In those instances, the potential impacts could be measured through an impact monitoring program designed to detect changes in biological and/or physical parameters. Quantitative estimates for changes in impacts for specific alternatives and locations cannot be made due to the variation of other site-specific environmental conditions.

The timing and location of unpredictable impacts, such as a fuel spill, are unknown, so a monitoring program is not feasible. However, implementation of a pre-determined mitigation response plan to contain, neutralize, and clean up the impacted area is possible. A follow-up assessment of biological impact, reclamation, and replacement could then be implemented.

Resource component	Impact	Mitigation under the alternatives	Further mitigation not covered under the alternatives	Irreversible and irretrievable commitments of resources
Topography	Localized modification of landscape	Reshape and stabilize during reclamation		
Mineral resources	Increased costs of compliance and less development	Lower water quality and reclamation standards		
Soils	Destruction of soil structure			X
	Loss of fine-grained soils through erosion	–Reshape to reduce slope angles –Revegetate to reduce rate of water runoff		
	Compaction in areas of roads and trails		Access allowed only during winter when ground is frozen and adequate snow cover exists	
Water resources	Greater stream channel gradient and reduced sinuosity	–Resestablish stream in original floodplain –Rebuild channel to approximate original channel		
	Increased sediment levels and turbidity during operations in stream	Use mining techniques to meet water quality standards for sediment and turbidity, including settling ponds, recycling and stream bypasses		
	Accelerated erosion from non-point sources	Revegetate and reshape		
	Erosion from roads		Careful design and construction will alleviate some	Some
Landcover	Reduced productivity shortly after mining	Reseeding and fertilization	Scarify, mulch	Some
	Loss of original riparian vegetation with organic soils			X
	Loss of fine-grained material in soils	–Reshape topsoil and overburden –Respread tailings and pond fines		
	Change of vegetation species, pattern and structure		–Leave strips of orginal vegetation as seed source –Redistribute topsoil in patchy pattern	Some
	Areas will remain barren or sparsely vegetated		–Replant with willow shoots	Some
	Loss of vegetation from roads Change of vegetation type from trails		Winter travel in non-forested areas, especially wetlands	Some

Figure 4-9. Mitigation for impacts from placer mining.

Continuation

Resource component	Impact	Mitigation under the alternatives	Further mitigation not covered under the alternatives	Irreversible and irretrievable commitments of resources
Wildlife	General habitat loss	Reseeding and fertilizing	Reclaim lost habitat—see Landcover	Some
	Crucial habitat loss		Locate development to avoid crucial habitats	
	Disturbance/ disruption of wildlife use pattern		Restrict or alter timing of operations, location, and extent of activities	Some
	Increased hunting pressure due to roads and trails		—Regulation by other agencies —Restrict access	Some
	Hazardous material spills		Plan to contain, neutralize,and clean up. Locate fuel operations and storage away from streams, storage areas diked and lined with impermeable material	
	Removal of nuisance animals		Dispose garbage and other waste so as to not attract animals	
Fisheries	Loss of fish habitat Decreased populations	Restore creek channel in floodplain with original gradient, contours, pools, riffles, etc.		
	Short-term loss of productivity			X
	Restriction of fish passage through channel		Construct culverts to ensure passage	
	Increased flow rate Low water especially in winter Loss of pools Silt and sedimentation from erosion	—Stabilize and reconfigure —Regrowth of vegetation		
	Loss of food and light penetration from siltation	Water quality standards		
	Loss of riparian cover		—Buffers of at least 100 feet around streams where physical alterations are permitted, except on mining claims —Replant with willow shoots	In some areas of mining claims
Cultural resources	Possible harm to undiscovered artifacts	Review cultural information, site inspection if cultural resource located during mining operations		
Subsistence	Impacts to natural system	See Other Resources		
	Changes in human technology and use patterns			Yes, unless regulations established

Figure 4-9 continued.

Continuation

Resource component	Impact	Mitigation under the alternatives	Further mitigation not covered under the alternatives	Irreversible and irretrievable commitments of resources
Recreation	Decrease primitive experience Increased access creating pressure, especially in primitive areas	Follow RMP for access development, i.e. no construction of roads in primitive areas	Remove or clean up old camps and facilities	
	Reduced wildlife viewing and hunting		See Wildlife	Some
Visual	Reduced visual quality and visual modifications from development and its effects	–Water quality requirements –Reconfigure tailings to approximate surrounding contours –Revegetation	Remove garbage, use natural appearing materials for buildings, etc.	Some
Economics	Reduced employment in mining and secondary industries resulting from increased compliance costs	–Gradient of water quality and reclamation standards		Some

Figure 4-9 continued.

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Chapter V
Public Participation

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5.1 Introduction

This chapter consists of three parts:

Part One describes the consultation and coordination process.

Part Two contains the names and qualifications of the persons responsible for preparing these EISs.

Part Three is a list of persons, organizations, and agencies reviewing the EISs.

This chapter is being prepared in the same manner for each of the EISs for the four watersheds of concern (Section 1.2). Public interest was focused on all the drainages, with some limited, specific references to each particular drainage. In some cases, data were collected on an area-wide basis. The preparers worked on all four of the documents, some to different extents.

5.2 Scoping and Issue Identification

5.2.1 Introduction

The BLM conducted a broad public and interagency consultation program throughout the development of this project, and this input has been incorporated into this document. Specific public and agency involvement is described below.

5.2.2 Scoping

The scoping process conducted by the BLM provided an opportunity for members of the public, special interest groups, the mining industry, and other agencies to assist in defining significant environmental issues. The main objectives of the scoping meetings were:

- To present an overview of this EIS.
- To identify the major environmental issues to be addressed in this EIS.
- To receive comments and questions regarding environmental impact concerns.
- To incorporate those comments and questions into the EIS planning process.

Initially more than 450 letters were sent to the public requesting comments, issues, and concerns to help in setting the parameters of the study, and to aid in developing a mailing list.

The scoping process was initiated for this EIS with the publication of a Notice of Intent to prepare an EIS in the Federal Register of August 18, 1987. The scoping meetings were also announced in local papers and on radio throughout the Fairbanks area, in remote communities, and in Anchorage. These announcements lead to formal meetings in the following locations, which were attended by various publics and agencies.

The scoping meetings and the approximate number of persons in attendance were as follows:

Date	Location	Attendance
Sept. 9, 1987	Central	44
Sept. 10, 1987	Livengood	34
Sept. 15, 1987	Chicken	33
Sept. 16, 1987	Fairbanks	51
Sept. 17, 1987	Anchorage	20
Oct. 5, 1987	Minto	31
Oct. 6, 1987	Birch Creek Village	10

Additionally, a total of 32 written comments were received. These and the oral comments taken at the meetings were summarized and reviewed by EIS team members. This review was to respond to the issues and concerns, and to provide a systematic procedure for EIS preparation. The issues and concerns were organized into general areas of concern for further evaluations.

Copies of these comments, as well as tapes of scoping meetings for review are available in the BLM State Office in Anchorage. The general areas of concern cited in public response letters are subsistence, NEPA, reclamation, recreation, water quality, sedimentation, fish and wildlife, habitat, economics, legal considerations, research, and engineering. All concerns identified during the scoping process were carefully considered during the development of this EIS.

The National Park Service (NPS) is conducting a cumulative EIS similar to the BLM effort. Several meetings were held to exchange information and ideas. The NPS and the BLM approached the issues of a cumulative EIS in a somewhat different manner due to their different management responsibilities.

The Corps of Engineers (COE) is cooperating with the BLM in these EISs. There has been useful exchange of information between the two organizations.

The U.S. Fish and Wildlife Service was solicited for information regarding any listed and proposed threatened and endangered species that may be present in the Fortymile River watershed. Informal consultation determined that no candidate endangered, or threatened species would be affected.

Meetings were held with the EPA during the scoping and data collection process. In particular, EPA was concerned that this EIS not become involved with the present reevaluation of proposed placer mining regulations. Several meetings were held to deal with technical aspects of water quality; these produced information to refine the water quality efforts and this led to several contracts with State agencies to assist BLM in data acquisition and analysis.

Meetings and briefings were conducted with the State of Alaska, including the Departments of Fish and Game, Environmental Conservation, Natural Resources, and Office of Management and Budget.

In addition to numerous meetings to gather data on resources and programs, the State of Alaska collected data and provided interpretation in several contractual reports. These reports included the topics of water quality, aquatic habitat and fisheries, biologic information, and a review of other consultant reports.

Meetings were conducted with the U.S. Bureau of Mines, State of Alaska Department of Natural Resources, and the U.S. Geological Survey to update the BLM on mineral resources and geology in the study area.

5.3 Names and Qualifications of Preparers.

Carol Belenski, Visual Information Specialist for seven years, with a total of 11 years with BLM. Mapping specialist and printing coordinator for numerous plans.

Frank Bruno, Writer/Editor, Bachelor of Arts - Journalism, 1974, San Jose State University. Five years with BLM.

Louis Carufel, District Fisheries Biologist, Bachelor of Science - Biology, 1948, St. John's University - Minnesota; Master of Science - Fish and Wildlife Management, 1960, Montana State University. Twenty years of Federal service.

Lee Douthit, Subsistence Coordinator, Bachelor of Arts - History, 1967, Texas Woman's University; Master of Arts - Anthropology, 1976, University of Texas at Austin; Ph.D. - Anthropology, 1978, University of Texas at Austin. Seven years with BLM as a Research Archaeologist, cultural resource manager, and subsistence coordinator.

Linda Du Lac, Land Law Examiner, Bachelor of Science - Resource and Recreation Management, 1974, Oregon State University. Nine years with the Forest Service and four years with BLM.

Bruce Durtsche, District Wildlife Biologist, Bachelor of Science - Wildlife Biology, 1978, Arizona State University. Twelve years with BLM. Three years with the State of Arizona.

Richard F. Dworsky, Project Manager, Bachelor of Science - Forestry, 1965, University of Michigan; Master of Science - Recreation, 1972, Colorado State University; Ph.D. - Forestry, 1986, University of Massachusetts. 20 years in natural resources planning and management. Former Chief of Forestry in Puerto Rico.

KJ Ferencak, Land Law Examiner, Associate Degree - Mining Engineering, 1981, Penn State University. Five years with BLM.

William S. Hauser, Mining Engineer, Bachelor of Science - Mining Engineering, 1977, Virginia Polytechnic Institute and State University. 10 years federal service.

Ronald G. Huntsinger, Physical Scientist, Bachelor of Arts - Biology, 1972, Humboldt State University; Graduate studies - Hydraulic Engineering and Watershed Management, Humboldt State University. Fifteen years experience in hydrology, watershed management, aquatic sciences, and undergraduate instruction in biology and physics.

Robert E. King, Anthropologist, Bachelor of Arts - History, 1970, Washington State University; Bachelor of Arts - Anthropology/Archaeology, 1970, Washington State University; Master of Arts - Anthropology/Historical Archaeology, 1973, University of Pennsylvania; Ph.D. - Anthropology/Ethnohistory, 1978, University of Pennsylvania. Six years with BLM. One year Anthropology contract work. Two years author, historian.

Paula V. Krebs, Geographic Information Systems Coordinator, Bachelor of Arts - Zoology, 1965, University of Colorado; Ph.D. - Plant Ecology, 1972, University of Colorado. 22 years experience in landcover/vegetation data production, applied plant ecology projects, ecological analysis and vegetative mapping, and graduate/undergraduate instruction in Botany and Resource Management.

Howard Levine, Land Law Examiner, Bachelor of Arts - Geography, 1981, San Diego State University. Seven years with BLM.

Thomas C. Mowatt, Geologist, Bachelor of Arts, 1959, Rutgers University; Ph.D., 1965, University of Montana. Twenty-five years professional experience in geology, geochemistry, chemistry, and environmental sciences, including private sector research and energy/mineral resources exploration/development/production, university teaching and research, state and federal government work. Active professionally in Alaska since 1970.

Lynette Nakazawa, Land Use Planner, Bachelor of Science - Soil Science, 1977, University of California at Berekley. 7 years experience with BLM as General Biologist and Land Use Planner.

Kim Pearce, Illustrator, Bachelor of Science, major - Illustration, minor - Biology, 1986. Nazareth College of Rochester, New York. One year with BLM.

Jacob Schlapfer, Land Use Planner, Bachelor of Science - Biology, 1987, Western Oregon State College. One year with the U.S. Forest Service. Two years with the U.S. Fish and Wildlife Service.

Page Spencer, Technical Coordinator, Bachelor of Science - Biology, 1972, University of Alaska - Fairbanks; Master of Arts - Ecology, 1975, University of Colorado; Ph.D. - Plant Ecology, 1981, University of Alaska, Fairbanks. Seven years with BLM.

John Thompson, Environmental Coordinator, Bachelor of Science - Economics and Political Science, 1975, South Dakota State University; Master of Science - Agricultural Economics, 1977, Purdue University. Employed by BLM 1977 to present.

Dave Vogler, Hydrologist, Bachelor of Science - Watershed Science (Hydrology), 1978, Colorado State University. Ten years subsequent professional experience in hydrology.

Susan M. Will, Archaeologist, Steese-White Mountains District, Bachelor of Arts, 1975, University of Alaska at Fairbanks. Nine years with BLM.

Support Personnel

Mike Clark, Cartograhic Technician

Debbie Llacuna, Clerk/Typist

Linda Mowatt, Miscellaneous Documents Clerk

Betty Ostby, Land Law Assistant

Aaron Ritchins, Cartographic Technician

Paul Schepler, Clerk/Typist

5.4 List of Persons, Organizations, and Agencies Reviewing the EISs.

Alaska Congressional Delegation

Don Young
Frank Murkowski
Ted Stevens

Alaska State Government

Alaska Dept. of Commerce and Economic Development
Alaska Dept. of Environmental Conservation
Alaska Dept. of Law
Alaska Dept. of Natural Resources

Alaska Governor's Office
Alaska Dept. of Policy Development and Planning
Governor, State of Alaska
Honorable John B. Coghill
University of Alaska - Anchorage Library
University of Alaska

U.S. Government

National Park Service
U.S. Bureau of Land Management
U.S. Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish & Wildlife Service

Organizations

Alaska Center for the Environment
Alaska Federation of Natives
Alaska Miners Association
Alaska Women in Mining
Birch Creek Council
Circle District Historical
Citizen's Adv. Commission on Federal Areas
Denali Citizens Council
Klondike Placer Miners Association
Northern Alaska Environmental Center
Sierra Club
The Wilderness Society
Trustees for Alaska

Businesses

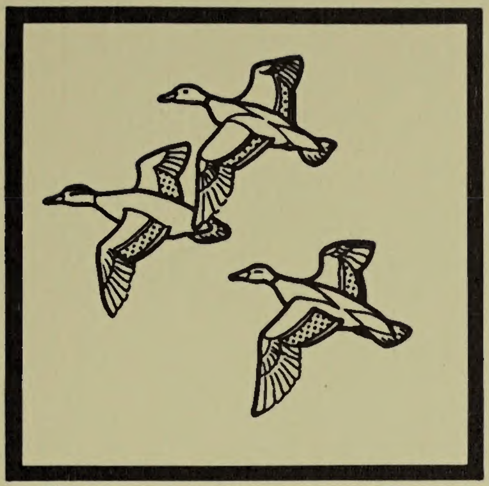
Alaska Gold Company
Alloy Welding & Machine
Alyeska Oil & Exploration
Anchorage District Recording Office
Apocalypse Design, Inc.
Bean Ridge Corporation
Beaver Kwit'chin Corporation
Clem's Backpacking Sports
Danzhit Hanlaii Corporation
Dinyee
Dot Lake Native Corporation
Doyon, Limited

Environlab
Fairbanks District Recording Office
Fairbanks Exploration
Fraley Equipment, Inc.
George Miller Construction, Inc.
Hungwitchin Corporation
Kachemak Mining Company
Little Squaw Gold Mining Company
Nerco Minerals Company
Ray Wolf Mining
Rife & McMillan
Robertson Mining Company
Russell/Norton/Drovin
Seth-de-ya-ha Corporation
T.C.C.
Tanacross, Inc.
Tihteet'Aii, Inc.
Tozitna, Limited
Usibelli Coal Mine, Inc.
Yukon Quest International, Ltd.

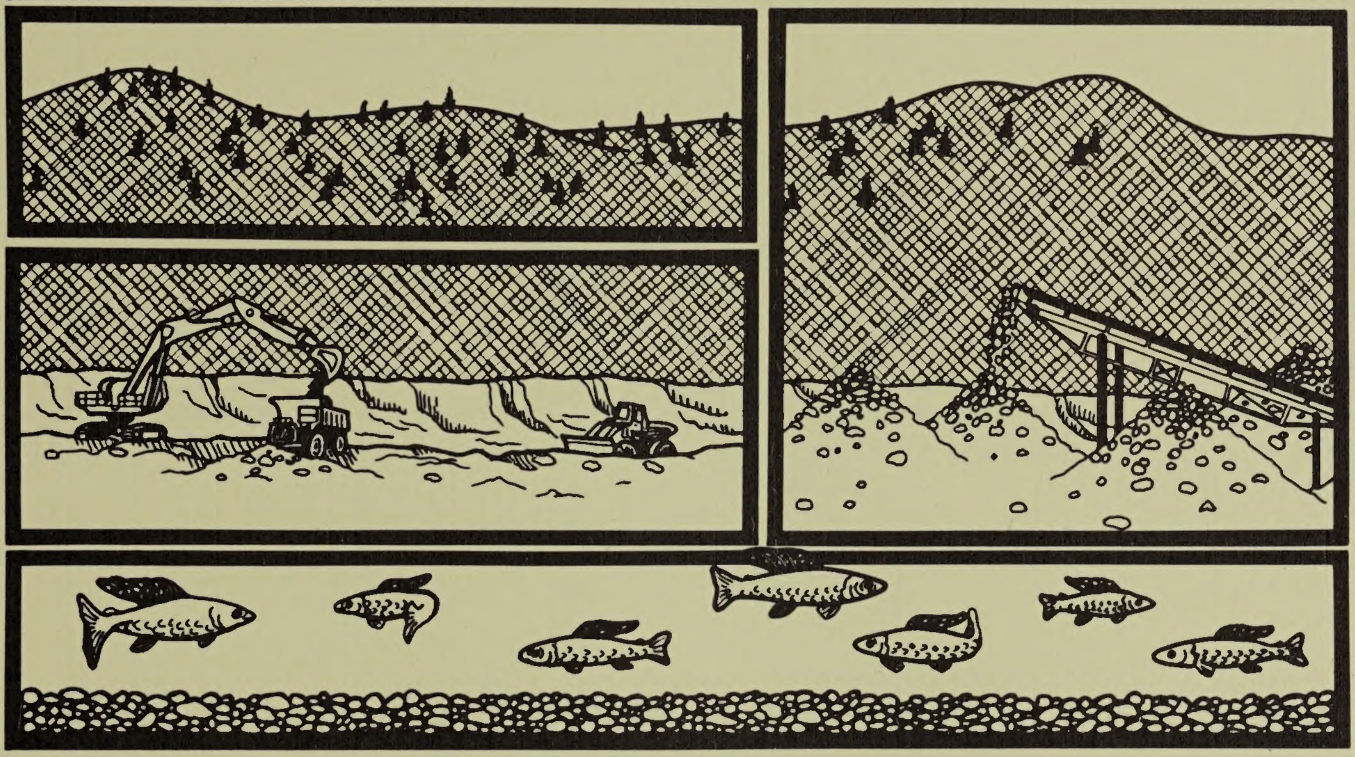
Libraries & Newspapers

Noel Wien Library
Alaska Resources Library
Z.J. Loussac Public Library

375 Individuals



MINTO FLATS



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Appendix A-1, Summary of Contractor Reports

1. Alaska Division of Geological and Geophysical Surveys (DGGS)

A cooperative agreement was entered into between the Bureau of Land Management (BLM) and the Alaska Division of Geological and Geophysical Surveys. The agreement provided additional funds and logistical support to DGGS for it to collect and analyze stream discharge, water quality, and biological information, and to carry out synthesis work, during 1987. The agreement called for DGGS to attempt to evaluate the cumulative environmental effects of placer mining in the Birch Creek, Beaver Creek, and Fortymile River drainages. In addition, DGGS would also attempt to assess the cumulative impacts of mining on subsistence activities in the Birch Creek and Minto Flats watersheds.

Two reports were produced by DGGS, "Water quality and discharge data from selected sites in the Fortymile and Tolovana Drainages, Summer 1987," written by Stephen F. Mack, Mary A. Moorman, and Linda Harris (ADGGS 1987), and "Compilation of Stream macroinvertebrate data for the Birch Creek, Beaver Creek, Fortymile, and Minto Flats drainages, Alaska," written by Mary A. Maurer (1987). Additional data was supplied to the BLM on computer diskettes for stream discharge in the Tolovana and Fortymile drainages by Steve Mack and John Bauer, the latter from the Alaska Department of Environmental Conservation. BLM receipt of these products is considered to constitute completion of the project.

2. Alaska Department of Fish and Game (ADF&G)

The Alaska Department of Fish and Game Habitat Division was contracted to prepare a report for the BLM on the aquatic habitat for all watersheds addressed in Sierra Club v. Penfold. The contract also called for ADF&G to provide the BLM with extant data on computer disks in the Lotus 123 format regarding hydrogeology, water quality, and geochemistry in the four watersheds of concern.

A final report entitled "Aquatic habitat and fisheries for seven drainages affected by placer mining: Chatanika River, Tolovana River, Goldstream Creek, Birch Creek, Fortymile River, Beaver Creek, Minto Flats," was filed with the BLM in December, 1987 (ADF&G 1987b).

3. Hagler, Bailly, and Company

Hagler, Bailly, and Company of Washington, D.C. was contracted to prepare an analysis of the economic and historical relationship of placer mining in Interior Alaska. The Hagler, Bailly study addressed the history of placer mining in the four watersheds, current status of the industry and its socio-economic impacts, and a projection of levels of future mining activity based on the results of research, synthesis, and interpretations of extant information. Hagler, Bailly, and Company subcontracted substantial portions of the study to L.A. Peterson and Associates of Fairbanks, Alaska. This work was facilitated, administered, and funded by BLM-Washington Office (680).

A draft report was sent to the BLM in December, 1987 (Hagler, Bailly and Company 1987).

4. Environmental Services, Ltd. (ESL)

Environmental Services, Ltd. provided a "Model Environmental Assessment (EA)" upon which the BLM could base the preparation of EAs for each placer mining operation starting in 1988 as directed by order of the District Court in the Sierra Club lawsuit. A draft report was submitted to the BLM in December, 1987, followed by a final report in January, 1988 (ESL 1987).

A second contract was entered into with ESL to provide BLM with data on wildlife for all four drainages. This report was provided to the BLM in January, 1988.

5. Arctic Hydrologic Consultants (AHC)

AHC was contracted by BLM to assess differences in water parameters between mined and unmined areas of Beaver Creek, Birch Creek, Fortymile River, and the drainages into Minto Flats (Chatanika River, Tolovana River, and Goldstream Creek.) AHC was also to provide a comparison of water quality values in mined areas with State and federal water quality regulations, as they apply to receiving water. In addition, AHC was to evaluate the state of the technology available for controlling wastewater quality at placer mining operations.

A final report dealing with Birch and Beaver Creeks and the Tolovana River was delivered to the BLM on February 29, 1988 (AHC 1988).

6. Peter E. K. Shepherd

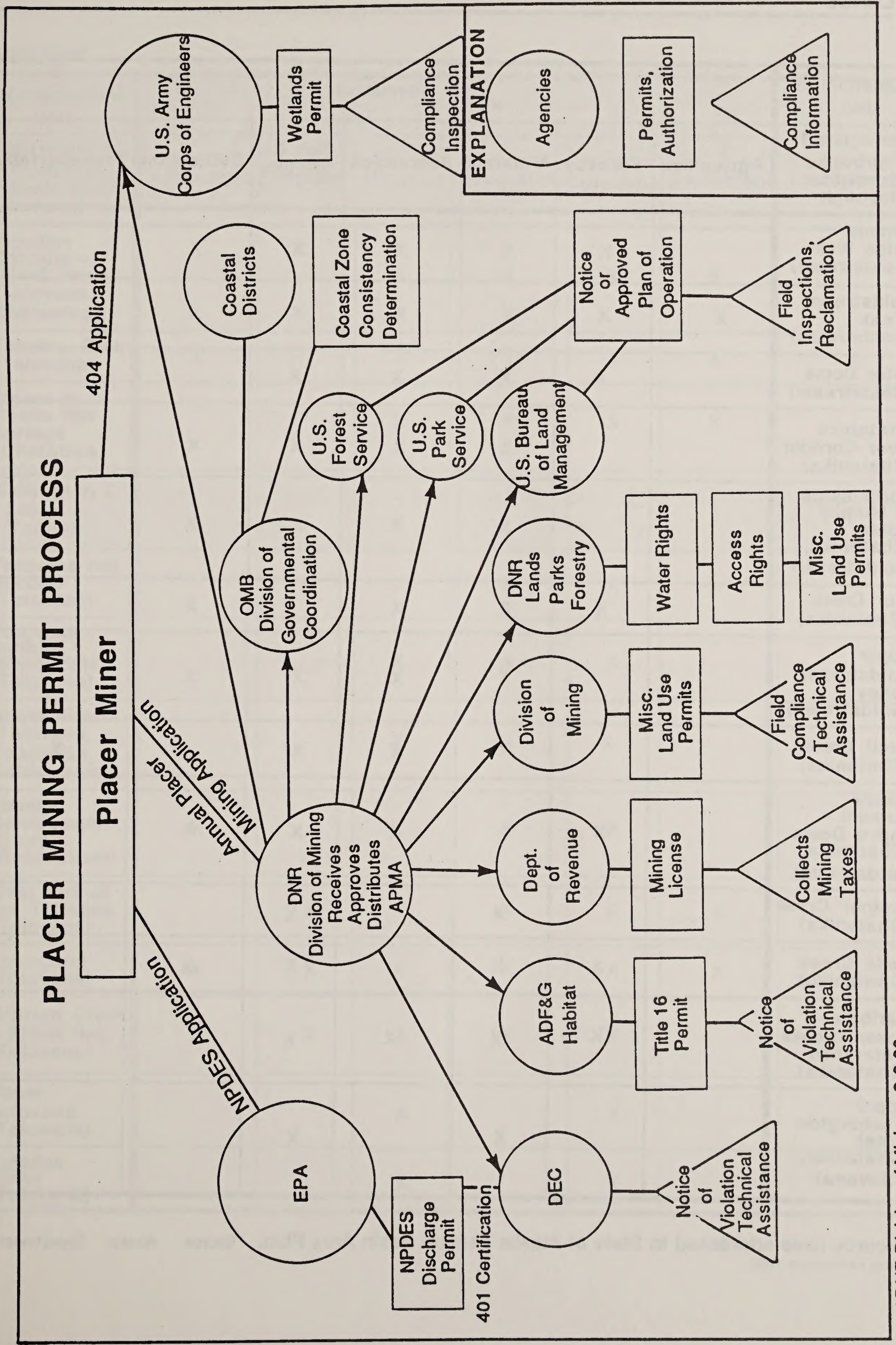
Mr. Shepherd prepared a report entitled "Impacts of Environmental Change on Minto Flats Subsistence Resources" (Shepherd 1987). The report examined the effects of placer mining on environmental habitats within the Minto Flats watershed and the relationship of those effects to subsistence uses and needs.

A final report was submitted to the BLM in January, 1988.

7. Dames and Moore

Dames and Moore was contracted to supply a report assessing the cumulative impacts of placer mining on the aquatic communities of the four watersheds. Additionally, Dames and Moore was to provide an assessment of the impact of placer mining within each stream basin on the aquatic communities of the receiving waters. A final report was sent to BLM in February, 1988 (Dames and Moore 1988).

Appendix A-2, Placer Mining Permit Process


PLACER MINING PERMIT PROCESS
Placer Miner
404 Application
Mining Application
Annual Placer
NPDES Application
U.S. Army Corps of Engineers
Wetlands Permit
Compliance Inspection
Coastal Districts
Coastal Zone Consistency Determination
OMB Division of Governmental Coordination
U.S. Forest Service
U.S. Park Service
U.S. Bureau of Land Management
Notice or Approved Plan of Operation
Field Inspections, Reclamation
DNR Lands Parks Forestry
Water Rights
Access Rights
Misc. Land Use Permits
DNR Division of Mining Receives Approves Distributes APMA
Division of Mining
Misc. Land Use Permits
Field Compliance Technical Assistance
Dept. of Revenue
Mining License
Collects Mining Taxes
ADF&G Habitat
Title 16 Permit
Notice of Violation Technical Assistance
EPA
NPDES Discharge Permit
401 Certification
DEC
Notice of Violation Technical Assistance
EXPLANATION
Agencies
Permits, Authorization
Compliance Information

ADNR Division of Mining 3-8-88

Appendix A-3, Resource Uses Discussed in Tanana Basin Area Plan for State Lands

Management Unit	Resources						
Subregion 1: Fairbanks North Star Borough	Agriculture	Forestry	Minerals	Recreation	Fish & Wildlife	Settlement	Transportation
Nenana Ridge West (Goldstream)		X	X	X	X	X	
Goldstream Creek (Goldstream)	X	X	X	X	X	X	
Ester Dome (Goldstream)		X	X	X	X		
Chatanika River Corridor (Chatanika)			X	X	X	X	
North Slope of Murphy Dome (Chatanika, Goldstream)			X	X	X	X	
Our Creek (Chatanika)		X	X	X		X	
Upper Goldstream Valley (Goldstream)			X	X	X	X	
Vault Creek (Chatanika)			X	X	X		X
Cleary Summit–Pedro Dome (Chatanika, Goldstream)		X	X	X	X	X	X
Juniper Creek (Chatanika)			X		X		
Belle Creek (Chatanika)		X	X		X	X	
Caribou–Poker Creeks Watershed (Chatanika)		X	X	X	X		
Upper Washington Creek (Chatanika, Tolovana)			X		X		

Resource uses addressed in State of Alaska Tanana Basin Area Plan. Source: Alaska Department of Natural Resources 1985.

Continued

Management Unit	Resources						
Subregion 1: Fairbanks North Star Borough	**Agriculture**	**Forestry**	**Minerals**	**Recreation**	**Fish & Wildlife**	**Settlement**	**Transportation**
Pipeline Corridor – Elliott Hwy. (Tolovana, Chatanika)			X	X	X	X	
Tatalina River (Tolovana)	X		X		X	X	X
Steese to Chena Hot Springs (Chatanika)			X	X	X	X	
Subregion 2: Lower Tanana							
Tolovana Hot Springs (Tolovana)		X	X	X	X		
Tolovana north of Minto Flats (Tolovana)			X	X	X		
Minto Flats (Tolovana, Chatanika, Goldstream)			X	X	X		
Lower Goldstream Creek (Goldstream)	X		X	X	X		
West Fork of the Tolovana (Tolovana)		X	X	X	X	X	
Livengood (Tolovana)	X	X	X	X	X	X	
O'Brien Creek – Elliott Hwy. (Tolovana)	X	X	X	X	X		
Upper Tolovana (Tolovana)			X		X		
Tatalina Valley (Tolovana)			X		X		

The Tanana Basin Area Plan for State lands (ADNR 1985) designates the uses that are to occur on State lands within the Tanana Basin, Subregions 1 (Fairbanks North Star Borough - "FN") and 2 (lower Tanana - "LT") of this plan encompasses Minto Flats and the tributary watersheds - Tolovana River, Chatanika River, Goldstream Creek - of concern to the Minto Flats environmental impact statement.

A summary of principal resource uses that are emphasized in the Tanana Basin Area Plan is presented in the previous figure, for State lands in each of these watersheds. These were considered by BLM, and integrated, as appropriate, into the development of the Minto Flats environmental impact statement.

Appendix B-1, Methodology for Forecasting the Future Number of Mines and Roads, and Acres of Reclamation and Disturbance

The number of expected future placer miners is difficult to calculate because of regulatory uncertainty: that is, standards may be so strict as to force many operators out of business, or the cost of compliance so high that the current price of gold precludes new investments. On the other hand, improved mining techniques and equipment may encourage miners to employ these increased capabilities. Therefore, it is believed that a good measure to estimate the number of future miners is to relate the number of miners to the price of gold.

As the price of gold increases or decreases the number of miners will increase or decrease accordingly. The EIS team developed relationships utilizing a one-to-one correspondence relating the price of gold to the number of miners.

Using these estimates, we reasonably expect that by 1998, the price of gold will be in the $600 per oz. range. This is a 23% increase over the highest 1987 price of $475 per oz. It is the expectation of this team that this also constitutes the worst- case scenario projecting over the next ten years. The following calculations were made to arrive at the expected future projections.

1. The 1981 acres disturbed was calculated from air photos.

2. The data for mines in 1987 were calculated from Alaska Placer Mining Applications and field knowledge of the BLM inspectors.

3. Estimations for 1998 were made by projecting that the price of gold would go up 23% by 1998.

4. The total number of miners in 1987 was calculated from Alaska Placer Mining Applications, and State Mineral Industry reports, and is the basis for projections of the number of miners in the future.

5. The proportional number of miners was calculated from the existing number of miners in each of the affected drainages, and included federal, State, and private operators.

6. Trends were extrapolated based on the existing operations.

7. Alternative futures were recalculated using a reduction factor in the 1987 EPA Economic Impact Analysis of Effluent Limitations report. In Table VIII-3 and VIII-4 of this report the EPA estimates that under various water quality standard options, a reduction of income will occur. This report concluded that for the small and medium operator the income reduction would range between 13% and 27%. If this is so, then we estimate that for Alternative A approximately 27% of the miners would not be able to afford the added cost of compliance. For Alternative B, no federal miner would operate at any cost.

8. Roads and trails were calculated by air photos, field inspections, and map analysis. The 1987 data is divided into federal, State, and joint components.

9. The projections for 1998 are estimated as follows: Current federal roads will exist and will be increased by 40% to account for new mining roads and reuse of existing mining roads. All trails will be converted to roads and counted as such. Roads and trails are reduced by the same 27% as discussed above to account for less mining because of water quality restrictions. Special notes are indicated for each drainage.

10. Acres of disturbance are calculated using an estimated 50-foot road width.

11. Mine disturbances are estimated at five acres in the first year, two additional acres in the second year, two additional areas in the third year and two additional acres of reclamation the third year. At the end of ten years we estimate that 23 acres of land will be disturbed, with 14 acres being reclaimed and total reclamation occurring at the end of the mine life for mines on federal claims. Federal, State, and private mines would be reclaimed on this schedule for Alternative A.

Appendix B-2, Assumptions For Worst Case Scenario

The Worst Case Scenario was analyzed using the same assumptions considered for analyzing the Proposed Action in Chapter Four with the following exceptions:

Facts

- There are about 348 active federal claims.
- There are about 2099 active State claims.
- There are about 268 Patented claims.

Assumptions

- All federal claims would be mined and reclaimed within next ten years.
- All State and Patented claims would be mined within next ten years with no reclamation standards.
- Ten acres would be mined on each claim.
- The Proposed Action performance standards would be used and met on federal claims.

- There would be 270 active mines per year (35 federal mines, 235 State and private mines).
- Ten acres would be mined per mine.
- 2,700 acres would be mined per year.
- There would be ten acres reclaimed per federal mine annually beginning in the second year (350 acres reclaimed in years two - nine and 700 acres in year ten).
- There would be approximately 27,000 acres disturbed directly by mining activity during ten year period.
- Roads and trails would be built to all active claims.

Appendix B-3, Methodology for Estimating the Administrative Cost of BLM's Surface Management Program and the Cost for Implementing Alternative B for the Minto Flats Drainages

The Steese/White Mountains District processed over 100 placer mining applications and inspected about 75 active mines during fiscal year 1987. For administrative cost estimation purposes, the cost of this program for fiscal year 1987 (approximately $175,000) has been divided into two parts, processing mining applications and field compliance and has been used as these EIS's predictive model. Considering the number of placer mining plans and notices processed,the amount of monitoring trips, and the compliance inspections completed, it was estimated that placer mining applications cost about $1,000 to receive, review, and process (which includes conferring with applicants and preparing Environmental Assessments) and about $800 to inspect each active mine. Inspection costs include transportation, two monitoring visits, two inspection trips to the mine site and preparation time for the compliance report. Both costs include between 10 and 15% overhead for management direction and training.

Administration of the Surface Management program for the Proposed Action would be a continuation of the program as administrated by the Steese/White Mountains and Kobuk Districts in Fiscal Year 1987. The estimated costs for processing a placer mining application and completing compliance inspections under the Proposed Action would be $1,000 and $800, respectively, for a total of $1,800 per mine.

Alternative A would require more stringent performance standards than the Proposed Action, so a 100% increase in compliance cost was estimated to be necessary to ensure compliance with these strict standards. An increase in BLM compliance cost would be attributed to additional inspector training and a greater number of compliance inspections and some additional costs are attributed to the COE for the enforcement of reclamation standards. The costs for processing a placer mining application and completing compliance inspections under Alternative A would be $1,000 and $1,600, respectively, for a total of $2,600 per mine.

Validity examinations would be conducted on all properly filed federal mining claims (roughly 350 claims in the Minto Flats drainages) and appraisals would be completed on all valid claims (all claims were assumed to be valid) in Alternative B. Conducting and completing validity examinations and appraisals were estimated to cost about $2,000 per claim, or approximately $700,000 for evaluating all of the claims in the Minto Flats drainages. The $2,000 claim evaluation cost was based on actual expenditures for similar evaluations conducted on Nome Creek in the nearby Beaver Creek watershed during the summer of 1987.

The net present value (NPV) of each claim was estimated by discounting minimum and maximum claim values over a 10 year period using a 10% discount rate. The minimum and maximum claim values were estimated by making the following assumptions:

Minimum Claim Value

- Net pay gravel thickness was three feet
- Ten acres of each claim contained gold-bearing gravel
- Minimum pay gravel value was $4 per cubic yard
- Claim was mined out sometime within next 10 years
- A 10% profit for the mining operation was realized

Maximum Claim Value

- Net pay gravel thickness was nine feet
- Ten acres of each claim contained gold-bearing gravel
- Maximum pay gravel value was $15 per cubic yard
- Claim was mined out sometime within next 10 years
- A 25% profit for the mining operation was realized

Using these minimum and maximum claim value assumptions, the gross values of gold mined would be approximately $194,000 and $2,178,000 respectively. Since the timing of the mining activity was unknown, the profit from the mining operation was spread equally over a 10 year period. This cash flow was then discounted at an annual rate of 10% to determine the NPV. The NPV for the minimum claim values would be about $12,000 and the maximum claim value would be about $335,000. The minimum and maximum NPVs for all 350 claims in the Minto Flats drainages are $4,200,000 and $117,250,000, respectively. This simplistic approach to determining NPV values was developed to present the magnitude of values that could be expected if the BLM selected Alternative B. The estimated claim values may not include the extreme minimum and maximum values that could exist on some claims.

Appendix B-4, Worst-Case Scenario for Economics

With an analysis of the worst case scenario, it is assumed that the total number of mines within the wtershed would increase from 30 to 270 (800%) over the next decade. If so, it is reasonable to also assume that mining expenditures, total output, mining employment, employment effect, mining income, and total income would also increase by about 800%. The economic impacts would be most significant in the local community of Livengood. Total employment and income would increase by about 5% in Fairbanks and total income would increase by an estimated 2%.

Local population within the study area would be expected to increase by an estimated 1,400 people, assuming that 29% of the additional miners would reside within the drainage or in nearby communities, and the population would increase by three individuals for each additional miner. This significant increase in community populations would cause equally significant increases in demand for public and community services.

Economic Impacts of the Four Watersheds Combined

The combined economic impacts of each alternative were analyzed to determine if there would be significant cumulative impacts. Although the number of people employed in placer mining would more than double, combined effects would change employment and income by less than 1% of the 1985 level within the Fairbanks and Alaska economy for each alternative. However, it is estimated that the combined worst-case analysis would increase the employment effect by 8% and 2% for the Fairbanks and Alaska economies respectively. Mining income would increase by about 2% and total income would increase by about 4% within the Fairbanks economy.

Appendix C-1, Geologic Time Scale

GEOLOGIC TIME SCALE

Era	System or Time Period	Series (rocks) or Epoch (time)	Approximate Age in millions of years (beginning of unit)
Cenozoic	Quaternary	Holocene	0.01
		Pleistocene	1.7 to 2.0
	Tertiary	Pliocene	5 to 6
		Miocene	25 to 27
		Oligocene	37 to 39
		Eocene	53 to 54
		Paleocene	63
Mesozoic	Cretaceous		136 to 138
	Jurassic		190 to 195
	Triassic		225
Paleozoic	Permian		270 to 280
	Carboniferous		345 to 350
	Pennsylvanian		
	Mississippian		
	Devonian		395 to 420
	Silurian		440 to 450
	Ordovician		ca. 500
	Cambrian		ca. 570
Precambrian			

Source: from Principles of Geology. 1975; Gilluly, James [and others]; San Francisco, CA; W.H. Freeman and Company; page 77.

D-1 Landcover Methodology

Analysis of acreages affected by mining and reclamation were based on projected disturbance from mining and associated mining access roads and trails (Figure 4-2).

1. Acreages for pre-1981 disturbance were interpreted from NASA high-altitude aerial photos taken from 1978 through 1981. The acreages correspond with figures for tailings given in Wolff and Thomas (1982) for Livengood and Crooked Creek. The aerial extent of disturbance interpreted from the photos probably underestimates total disturbance since the acreages were calculated from areas that still show evidence of tailings piles and barren ground.

2. Figures taken from 1987 APMAs show that approximately 50% of mining disturbance on federal claims in the Birch Creek watershed was on old tailings, and 50% on new, previously unworked ground.

3. Mining disturbance on new ground is estimated to result in a 60% vegetation cover after reclamation and regrowth, with 40% remaining barren.

4. Mining disturbance on new ground which is not reclaimed is estimated to result in 75% barren, with a 25% vegetated cover after approximately 40 years. Washplant tailings have a greater proportion of fine-grained materials than tailings.

5. Disturbed areas on tailings would be extensively reclaimed with Alternative A. The addition of fine materials, fertilizer, and possible seeding would increase vegetative cover after regrowth. This level of reclamation is estimated to result in 50% vegetative cover, with 50% remaining barren.

6. Roads are assumed to remain barren, while trails are considered to be changed in vegetative cover and composition, but not rendered barren.

7. Total acreages for each alternative were calculated by adding historic disturbance, projected disturbance with associated regrowth for each alternative, and the contribution from roads or trails. Estimates for acreages for all alternatives are in Figure 4-2.

Appendix D-2, Recommended Mitigation Measures for Wildlife

Guidelines for development of measures to mitigate impacts to wildlife resources included prioritization of the types of mitigation. The highest priority was to avoid the impact, a lesser priority was to minimize or rectify the impacts, and last priority was to replace the impacted resource. On-site or in-basin mitigation within the stream or drainage where the impact occurred was favored, as was "In-kind" mitigation, where the impacted species would be replaced by the same species thereby reducing potential disruptions to the system's ecology and harvest management problems.

The type of management control or mitigation required for any impact depends on the type and extent of the impact, and the magnitude of the effects. Therefore, each impact needs to be well defined before specific mitigation measures can be identified. Based on identification of the impacts, expected short-term (5-10 years), continuous or long-term (up to 20 years or beyond), and unpredictable impacts are the types that will require mitigation. Potential measures suitable for mitigating short-term and continuous or long-term impacts resulting from the distinct components of the Proposed Action and alternatives are presented in the figure in this appendix. The potential mitigating measures listed for each mining action component are technically feasible and are considered appropriate for the anticipated magnitude of impact.

In order to provide an appropriate level of mitigation for any impact, the extent and magnitude of the impact effects on the wildlife resource must be known. The figure in this appendix summarizes expected impacts and provides an estimate of effects on the wildlife resources. In some cases, impacts cannot be precisely estimated due to their complexity, lack of information, or the low probability of their occurrence. Additional information is then required to develop suitable mitigation. In those instances, the potential impacts will need to be measured through an impact monitoring program designed to detect changes in biological and/or physical parameters. Changes that exceed some maximum acceptable level or threshold (as determined by the regulatory agency or agencies) would trigger a mitigation response plan. This plan can be developed for expected short-term impacts, continuous or long-term impacts, as well as potential impacts. A monitoring program could be implemented to 1) more accurately determine the impacts to the present and potential future population of a species, 2) determine timing, extent and duration of habitat(s) lost, 3) evaluate the effectiveness of habitat replacement or reclamation, and 4) determine the need for possible modification of previous management decisions. This long-term wildlife/mining impact monitoring program would be conducted cooperatively by BLM and ADF&G to provide information regarding the effects of mineral development activities, adequacy of mitigative measures (i.e. reclamation) and accuracy of impact predictions.

The timing and location of unpredictable impacts, such as a hazardous material spill, are unknown, so a monitoring program is not feasible. However, implementation of a pre-determined mitigation response plan to contain, neutralize, and clean up the impacted area is possible. A follow-up assessment of biological impact, reclamation, and replacement could then be implemented. The Alaska Department of Environmental Conservation has prepared a hazardous material spill contingency plan.

When specific mineral development actions are proposed in the area, a site-specific analysis of effects will be developed through the environmental assessment process, as required by the National Environmental Policy Act and the Surface Management Regulations (43 CFR 3809). As a result of this process, restriction or alteration of timing, location and extent of a mineral development activity may be required to avoid or minimize adverse effects and/or to avoid unnecessary or undue degradation. Possible crucial habitats, and timeframes, that surface or aerial use restrictions may be required by BLM, are listed in Table 9-1 and 9-2 of the Record of Decision for the Resource Management Plan for the White Mountains National Recreation Area (DOI 1986d).

Mitigative measures to replace/reclaim habitat that has been altered, removed, or lost as a result of mineral development activities are an inherent part of the Proposed Action and each Alternative (Section 2.5). Measures can be incorporated into the restoration techniques required in order to enhance the recovery process of wildlife habitat. For example, materials can be sorted as part of the mining operation, with larger materials deposited in the lower reaches of tailings and smaller materials above. This is especially important in previously mined tailings where there is no layer of overburden and top soil. Durst (1984) found that revegetation will be enhanced if the recontouring effectively reduces the slope of tailings, and reduces the height of tailing above the water table. In addition, plants will colonize more readily if recontouring leaves a "patchy" landscape that includes low wet spots with gentle slopes and hummocks. In cases where topsoil and/or fines are very limited, better results may generally be obtained by spreading these materials in a patchy manner than by evenly spreading them over only part of the area to be reclaimed. The varying degrees and effectiveness of the reclamation efforts required by the Proposed Action and each alternative have been incorporated into the analysis and are discussed in their respective sections (see Sections 4.6.1- 4.6.5). The success of reclamation varies from site to site and depends on elevation, aspect, slope, soil, water, and many other factors.

Mineral development action component	Habitat impact	Potential effect	Potential mitigating measure	Effectiveness
ACCESS				
Construction of permanent gravel roads	Habitat loss (approx. 50 foot width)	Reduction in numbers	– Locate crucial use areas – Plan road alignments to avoid crucial areas	Would avoid or minimize loss of crucial habitat
Use of roads/trails/river access	Disturbance/ disruption (approx. 1/2 mile either side)	– Alter habitat use – Increased harvest	– Locate crucial use areas – Plan trail alignments to avoid crucial areas – Restrict or alter timing, location & extent of activity – Monitor use of roads/trails/riverboats – Monitor human use conflicts in crucial habitats – Monitor human use of wildlife resources – Coordinate with ADF&G	– Would avoid or minimize disturbance/disruption of wildlife use areas – Would provide information about effects, effectiveness of mitigation & accuracy of impact predictions – Would keep ADF&G informed
Potential upgrading & more roads/trails/river access	Increase in habitat loss, disturbance/ disruption	Increase in above potential effects	– Locate crucial use areas – Plan trail alignments to avoid crucial areas – Restrict or alter timing, location & extent of activity – Monitor use of roads/trails/riverboats – Monitor human use conflicts in crucial habitats – Monitor human use of wildlife resources – Coordinate with ADF&G	– Would avoid or minimize disturbance/disruption of wildlife use areas – Would provide information about effects, effectiveness of mitigation & accuracy of impact predictions – Would keep ADF&G informed
FACILITIES				
Construction of gravel pads, etc.	Habitat loss	Reduction in numbers	– Locate crucial use areas – Plan facility locations to avoid crucial habitats – Reclaim/replace lost habitat (see below)	– Would avoid or minimize loss of most crucial habitat – Would replace wildlife habitat in 5 – 50 years (see below)
Human habitation of facilities/campsites	Disturbance/ disruption (approx. 500 foot radius)	Alter habitat use	– Restrict or alter timing, location & extent of activity – Monitor human use conflicts in crucial habitats	– Would avoid or minimize disruption in crucial habitats
Solid waste disposal	Remove nuisance animals	Reduction in numbers	– Dispose of garbage & other waste in a manner to not attract wildlife – Comply with ADEC solid waste disposal regulations	Would avoid or minimize attraction of bears & other wildlife
OPERATIONS				
Stripping, mine cuts, stockpiles, settling basins	Habitat loss	Reduction in numbers	– Locate crucial habitats – Plan operations actions to avoid crucial habitats – Monitor overall habitat losses – Monitor reclamation effectiveness	– Would avoid or minimize loss of some crucial habitats – Would provide information about effectiveness of mitigation & accuracy of impact predictions

CONTINUATION

Mineral development action component	Habitat impact	Potential effect	Potential mitigating measure	Effectiveness
OPERATIONS cont'd				
Stripping, mine cuts, stockpiles, settling basins	Habitat loss	Reduction in numbers	– Reclaim by recontouring, respreading fines & topsoil, fertilize &/or reseed &/or replant willows [1] – Reclaim by recontouring, respreading available topsoil, natural succession [2] – Reclaim by recontouring, respreading fines, fertilize &/or reseed with native plants (no shrubs)[3]	– Would replace habitat in 5 – 25 years [1] – Would replace habitat in 50 years [2] – Would replace habitat in 25 – 35 years [3]
Operation of machinery	Disturbance/ disruption (approx. 1/2 mile radius)	Alter habitat use	– Restrict or alter timing, location & extent of activity – Monitor operations, disturbance/disruption in crucial habitats	– Would avoid or minimize disturbance/disruption in crucial habitats
Fuel spills	Habitat loss	Reduction in numbers	– Response plan to contain, neutralize & clean up – Comply with ADEC hazardous materials regulations	– Would avoid or minimize size, extent & duration of habitat loss

[1] Source: Sisk, unpublished data

[2] Specified in Proposed Action and Alternative B

[3] Specified in Alternative A

Figure D – 2(a). General effects of mineral development actions and their potential mitigation measures.

Appendix E-1, Methodology for Sediment

In 1973, the EPA estimated the various erosion rates from various land uses. While this data is based on nationwide rates and does not specifically represent Alaska, it does provide a set of parameters that can be used as a comparison. This comparison focuses on the relative contribution of ongoing and historic placer operations; proposed future contributions may thereby be placed in perspective.

One of the reasons for using this type of methodology is the issue of data. In theory, it is possible to calculate the sediment that can be put into a stream and predict the amount that will pass by a point downstream. In practice, such a task is difficult, requiring a considerable amount of sediment, hydraulic, and hydrologic data. More specifically, the types of soils, ground cover, slope and aspect, nature of the operation, microclimate precipitation, and a host of other variables suggest that an overall approach be developed for comparative purposes. Such data are not available for the enjoined watersheds, except for some limited data, especially on Birch Creek (ADEC 1986b). The EIS team developed their own approach using the EPA data, then compared it to the Birch Creek data:

1) EPA (1973) estimated the representative rates of erosion from various land uses, in annual tons per square mile to be:

Forest	24
Abandoned surface mines	2,400
Harvested forest	12,000
Active surface mines	48,000
Construction	48,000

2) EPA methodology does not identify the relative contributions to water courses or normal sediment traps.

3) Acreage figures were used from ongoing and projected disturbances and converted to a square mile ratio.

4) Representative rates and areas were multiplied to get suggested comparative rates.

5) Some specific assumptions were made, which in the final analysis means that our projections probably overstate the actual magnitude of the problem. The assumptions include:

a. Forest lands are estimated to be 90% of the basin, and forest cover is defined as all covered ground.

b. No regrowth and regeneration occur on previously disturbed lands.

c. Disturbances continue past 1998 but reclamation will occur at the end of the mining operation.

d. Construction of roads and other development will contribute less sediment on successive years, but this progressive decline is not calculated here.

6. Figure 3-1 is a summary of this evaluation.

7. When compared to Birch Creek (ADEC 1986b) the following generalizations can be made:

a. The average estimated sediment load for two undisturbed basins (Boulder Creek - 30.47 square miles and Bedrock Creek - 10.35 square miles) was 0.0010 and 0.0038 tons per hour per square mile, respectively. If these rates are projected to the entire Birch Creek drainage, and figured on a 24-hour day and a 200-day season, the projected sediment rates are 11,234.6 and 42,774.1 tons per 200-day season. This is compared to our idealized sediment from forests of 46,224 tons per year.

b. The average estimated sediment load for Birch Creek at the Steese Highway (which includes all mined areas) was 0.014 tons per hour per square mile during the 1985 field season. For projection purposes, all things being equal, using the Dames and Moore (ADEC 1986b) study, the BLM would estimate that, based on a 200-day season, about 143,800 tons of sediment would find its way past the bridge monitoring station. The idealized sediment rates were calculated to be 202,820 tons per year. So the BLM estimates, in a very general qualitative way, are within about 30% of the calculated values of the ADEC study.

8. Tons of sediment per year and tons of sediment for an Alaska 200-day season are converted to tons per day.

Appendix E-2, Staking and Operating a Federal Mining Claim

The following paragraphs tell how to locate a federal mining claim and what the BLM's requirements are for operation on a claim.

A certain degree of background research is necessary to identify what general area a prospective miner may be interested in. The interested party must identify where, by legal land description, he/she intends to conduct activities. Examination of a 1:2,500,000 (E series) map will aid in the proper identification of BLM lands and, when used in conjunction with the master title (MT) plats found in the public room, will help identify lands open to mineral entry. Proper identification and marking of the prospect on a topographic map to more clearly define the area of interest will aid the proponent in finding the lands of interest in the field.

After determining where the desired location is, the proponent must travel to the actual site and determine if any location markers exist. If not, the claim must be "located" by establishing clearly visible location posts or markers and then recording the claim with the proper authorities, i.e., the State of Alaska's Recording Office and the BLM (of course, a prospective miner can take a chance and not go through the process of claim location, but he/she then runs the risk of having someone else staking (locating and recording) the claim and being legally able to force them off the claim.) Once a claim is properly located and recorded, $100 worth of assessment work must be performed on the claim every year with proof of the work performed filed by December 30th annually with the BLM. If this is not accomplished and the claimant desires to keep his/her claim, he/she must file with the BLM by December 30th annually a Notice of Intent to Hold.

While it is to the advantage of any prospective miner to legally locate and file his/her claim there is no requirement that a miner must do so prior to conducting mining activities.

The filing of a Notice, as per 43 CFR 3809.1-3, is required of any operator (other than casual use operators or recreational miners as described in 43 CFR 3809.1.2) whose facilities disturb 5 or less acres. A Notice filing must include the name and mailing address of the mining claimant and operator, if other than the claimant; when applicable, the name of the mining claim(s); a statement describing the activities proposed and their location in sufficient detail to locate the activities on the ground; the approximate date of the onset of the activities; a description of the access routes to be constructed; a description of the equipment to be used; a statement that all reclamation of disturbed areas will be accomplished in accordance with 43 CFR 3809.1-3(d); and a statement that reasonable measures will be taken to prevent unnecessary or undue degradation of the Federal lands. No recommended format for the Notice exists. (This portion may be under judicial review by the District Court).

The filing and approval of a Plan of Operations, as per 43 CFR 3908.1-4, is required of any operator whose facilities disturb more than 5 acres. A Plan filing must include the above listed information as well as a map. preferably topographic, showing existing or proposed routes of access, aircraft landing areas, or other means of access, and size of each area where surface disturbance will occur; and measures to be taken during extended periods of non-operation to maintain the area in a clean and safe manner and to reclaim the land to avoid erosion and other adverse impacts.

BLM may do the following things to ensure compliance with the reclamation of mining sites: [see other agency permits (Chapter One)]

- Conduct field compliance inspections/monitoring
- Develop reclamation plans with the operator/claimant
- Develop mitigative measures/site specific stipulations
- Require mandatory bonding
- Seek court intervention
  a. Temporary restraining order
  b. Injunction from further activity

- Institute fines or civil penalties
- Perform reclamation, and go to court to recover costs from the operator/claimant

Appendix E-3, Comparison of Reclamation Requirements and Estimated Costs

Reclamation Requirements		
Proposed Action	**Alternative A**	**Alternative B**
Grade tails, stabilize soils, stabilize streams, bypass	Reseed and fertilize, reestablish stream channel	No mining, post-1981 unreclaimed, ground to follow Alt. A standards

Cost Per Acre in 1987 Dollars		
Proposed Action	**Alternative A**	**Alternative B**
$500-tailings $500-soils	$500-tailings $500-soils $250-fertilizer $100-seed $350-stream	$500-tailings
$1,000 total	$1,700 total	$500 total

Comparison of reclamation requirements and estimated costs. Sources: Reclamation Research Plans for Alaska National Park System Units, 1986; Alaska Department of Natural Resources, Division of Mining; Bureau of Land Management estimates.

Appendix F-1, Regulatory Program of the U.S. Army Corps of Engineers, Alaska District

The U.S. Army Corps of Engineers (COE) is the federal permitting agency for work proposed in waters and wetlands. Within the State of Alaska, this program is administered by the U.S. Army Engineer District, Alaska.

As its primary regulatory responsibilities, the COE has jurisdiction over the construction of any structure in or over navigable or tidally influenced waters, the excavation of material from navigable waters, the obstruction or alteration of navigable waters, and the placement of dredged or fill material into waters of the United States, including wetlands.

Work proposed in navigable waters of the United States is subject to Section 10 of the Rivers and Harbors Act of 1899. This Act requires a Department of the Army (DA) permit be obtained prior to performance of any construction or activity that alters the course, current, condition, or navigable capacity of a navigable water.

Work proposed in waters of the United States is subject to the Clean Water Act. Section 301 of the Act requires that a DA permit be obtained prior to the placement of dredged or fill material into waters, including wetlands. Permit specifications are identified in Section 404.

Within the Birch Creek, Beaver Creek, and Fortymile River drainages, no navigable waters subject to Section 10 of the Rivers and Harbors Act of 1899 are present. However, extensive areas subject to Section 404 of the Clean Water Act are present. Within the Minto Flats drainage,certain waters have been designated navigable by the COE and are subject to Section 10 of the Rivers and Harbors Act of 1899. Like the other drainages, extensive areas within the purview of the Minto Flats Environmental Impact Statement (EIS) are subject to Section 404 of the Clean Water Act.

The regulations implementing the COE's permit program are found at 33 CFR 320 et seq. As identified in the regulations the COE's mandate is to consider the public interest when determining whether proposed work should be authorized. No work shall be permitted unless it is found to be in the public interest. Further, waters of the United States and a regulated activity are not restricted by land ownership. A COE permit may be required for work proposed on private land as well as for work proposed on public land.

If a proposed project is located in an area subject to COE jurisdiction and requires issuance of a permit, a formal application must be submitted. A public notice describing the proposed work would be prepared and issued to other federal, State, and local agencies and to members of the public for review and comment. If the project is controversial, a public hearing may also be held. In addition to review of the proposed project by other agencies and individuals, the COE conducts its own public interest review.

The decision whether to issue a permit will be based on an evaluation of the probable impacts, including the cumulative impacts, of the proposed activity and its intended use on the public interest. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal must be considered including the cumulative effects thereof. Among the factors considered are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, land use, navigation, safety, and the needs and welfare of the people among others.

As a result of the public interest review, proposed work may be authorized, denied, or issued with special conditions. Additionally, an applicant may be requested to modify potentially detrimental aspects of the proposed work to comply with the intent of the Clean Water Act or to other laws that apply to the review process. A schematic presentation of the COE's permit application review process is shown in Figure F-1.

In addition to issuance of individual permits, proposed work may also be issued by existing Nationwide permits found in the COE regulations, by General Permit (GP), or by Abbreviated Processing Procedures (APP). In its review of proposed placer mining work, the Alaska District is presently identifying those projects not subject to COE authority, those projects subject to COE authority and authorized under Nationwide Permit, and those projects suitable for review under individual permit application review procedures. A GP for placer mining is also being considered and may be in use by late spring, 1988. In addition, an APP is being developed but is not anticipated to be in effect for the 1988 mining season. Once in place, however, those projects meeting the terms and conditions of either procedure could receive expedited processing.

Though not considered to be an inclusive list, many of the activities associated with placer mining subject to COE authority are identified below. Additional information on work subject to COE authority may be found in the COE's regulations.

For the COE, preparation of BLM's EISs will provide analysis and documentation from which future COE authorization of work proposed in the areas subject to the EIS would be tiered. Under individual permit application review procedures, project specific environmental assessments may be tiered from each EIS. In addition to the analysis and discussion of anticipated impacts contained in each EIS, the particular circumstances of each project, including analysis of site-specific impacts, would be included in the environmental assessment prepared for each project. Second, development of GPs for work proposed in areas subject to EIS preparation could be tiered from each EIS. Third, APP could be tiered from the subject EISs.

For projects being reviewed under individual permit application review procedures or under APP, the COE will also evaluate each project under the Section 404(b)(1) Guidelines prepared jointly by the COE and the EPA (40 CFR Part 230). In addition to determining whether the proposed work meets standards established by the Guidelines, the Section 404(b)(1) analysis includes a review of project alternatives in an effort to avoid or minimize anticipated adverse impacts to aquatic values. For works authorized under a GP, a Section 404(b)(1) analysis would be prepared for all work anticipated to be authorized under each GP. Section 404(b)(1) analysis of each project would not be prepared.

The COE's Regulatory Branch will assist any individual, agency, company, or corporation in determining whether issuance of a permit for proposed work is required. More detailed information concerning the COE regulatory program, including information concerning the regulation of activities associated with placer mining, may be obtained by writing to the COE at the following address:

Regulatory Branch
Alaska District
U.S. Army Corps of Engineers
P.O. Box 898
Anchorage, Alaska 99506-0898
or by telephoning (907) 753-2712 or toll free at (800) 478-2712.

Activities Subject to Section 404 of the Clean Water Act

The following activities associated with placer mining are subject to Section 404 of the Clean Water Act when performed in waters of the United States, including wetlands:

1. the stockpiling of overburden;

2. the stockpiling of placer bearing material prior to processing;

3. the placement of dredged and/or fill material associated with work such as stream diversions, reservoirs, impoundments, and fish bypass channels; and dams, dikes, and berms related to water diversion, collection, and/or retention;

4. the placement of dredged and/or fill material associated with construction of roads, i.e., roads accessing the mine as well as roads located within the mined area(s). NOTE: Nationwide Permit Number 14 may apply for minor stream crossings;

5. the placement of dredged and/or fill material associated with the construction of settling basins, including the construction of access roads, berms, dikes, and similar works;

6. the placement of dredged and/or fill material associated with the excavation of bedrock drains, drainage ditches, and similar works;

7. the placement of dredged and/or fill material associated with the construction of buildings, staging areas, equipment facilities, airstrips, and similar works; and

8. the placement of dredged and/or fill material associated with reclamation.

Activities Subject to Section 10 of the Rivers and Harbors Act of 1899

The following activities associated with placer mining are subject to Section 10 of the Rivers and Harbors Act of 1899 when performed in navigable waters of the United States:

1. all activities listed under work subject to Section 404 of the Clean Water Act above;

2. dredging; and

3. any other activity in, on, or over a navigable water that could affect the course, current, condition, or navigable capacity of a navigable water.

Typical Corps permit review process

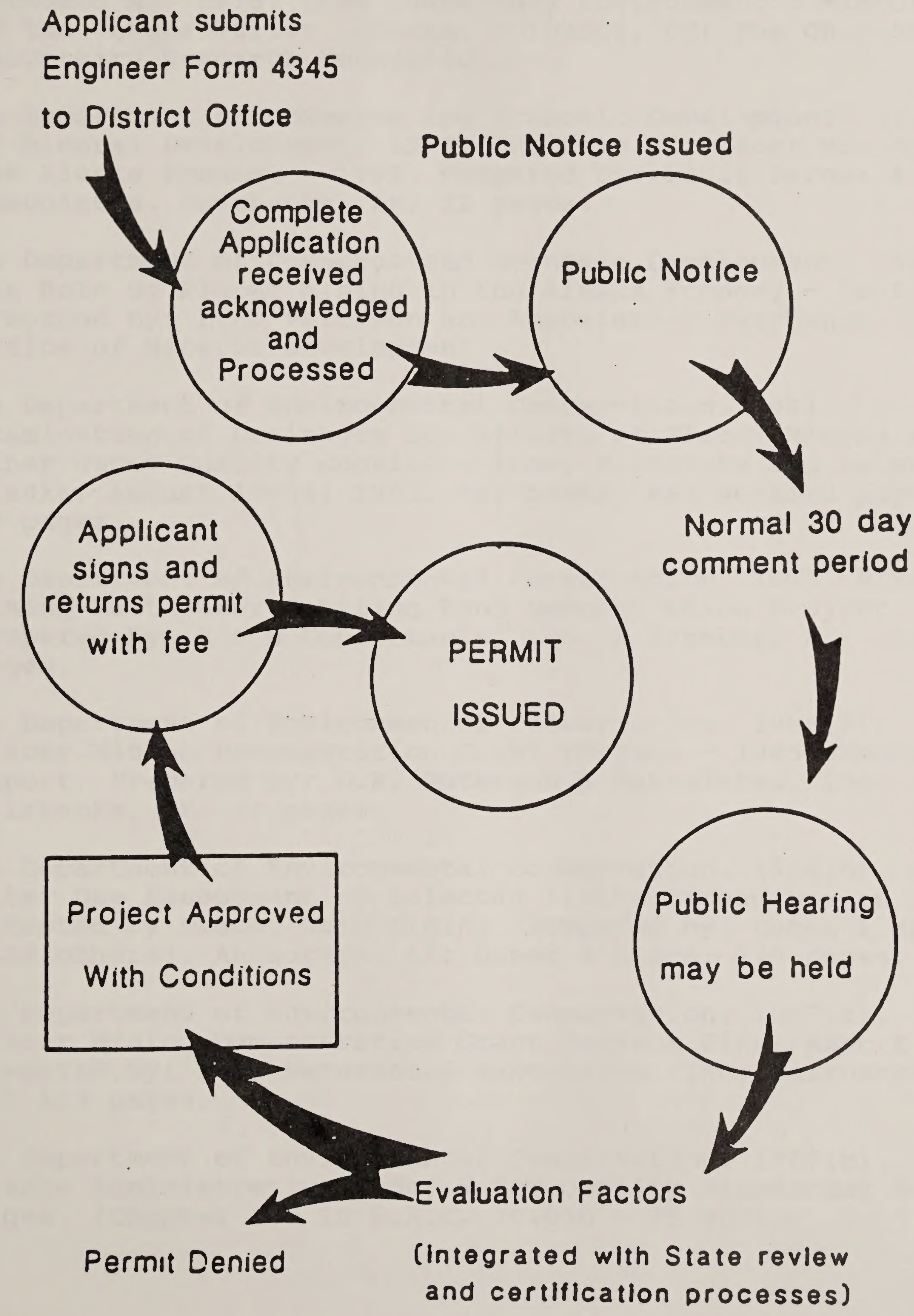

Applicant submits
Engineer Form 4345
to District Office
Public Notice issued
Complete Application received acknowledged and Processed
Public Notice
Normal 30 day comment period
Applicant signs and returns permit with fee
PERMIT ISSUED
Public Hearing may be held
Project Approved With Conditions
Evaluation Factors
(integrated with State review and certification processes)
Permit Denied

Figure F-1. Permit Review Process.

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Glossary

Active Mining Claim: A current BLM mining claim in which all assessment and other requirements have been met, although no active mining may be taking place.

Alevius: A newly hatched salmon with yolk sac still attached.

Allochthonous: Formed elsewhere and transported from a distance.

Alluvial Fan: A low, outspread mass of loose rock material shaped like an open fan deposited by a stream at the place where it issues.

Alluvium: Deposits laid down by modern rivers and streams.

Anadromous: Aquatic organism migrating from marine waters to freshwater to spawn.

Alteration Zone: An area being modified or changed in any noticeable way.

Aquifer: A body of rock that is sufficiently permeable to convey ground water and to yield economically significant quantities of water to wells and springs.

Areal: A multi-leveled or spatial relationship between two or more resources.

Aspect: A particular status or phase in which something appears or may be regarded.

Association: In an abstract sense, a group of communities or stands that are classified together because they meet certain standards of similarity.

Aufeis: An ice feature formed by water overflowing onto a surface, such as river ice or gravel deposits, and freezing.

Batholith: A large plutonic mass that has more than 40 square miles of surface exposure and no known floor.

Benthic: Relating to or occurring at the bottom of a water body.

Biomass: Amount of living matter as in a unit area or volume of matter.

Biotite: A general term to designate all iron and magnesium- bearing micas.

Braided Stream: A stream flowing in several dividing and reuniting channels resembling the strands of a braid. Typically within a wide floodplain.

Bryophytes: Non-flowering plants comprising of the mosses and liverworts.

Burin: A steel tool with an oblique point and rounded handle for carving stone, or a prehistoric chisel-like flint tool.

Candidate Species: Those species (plant or animal) included in the Federal Register "Notice of Review" listing that are being considered by the FWS for listing as threatened or endangered species.

Chaining: Cultivating implement used to spread and distribute debris; usually devised of link chains.

Channelize: A non-natural rerouting of a stream course.

Cirque: A deep, steep-walled, half-bowl-like recess situated high on the side of a mountain and commonly at the head of a glacial valley and produced by the erosive activity of a mountain glacier.

Classification: Separation of materials by size.

Clay: Sediment particles less than 0.002 mm in equivalent spherical diameter.

Climax: A more or less stable biotic community which is in equilibrium with existing environmental conditions and which represents the terminal stage of an ecological succession.

Coagulation: A chemical process that reduces turbidity in a water body.

Code of Federal Regulations (CFR): Regulations promulgated and enforced by federal agencies which have the full force of law.

Coliforms: Relating to, resembling, or being a bacilli that resides in vertebrate intestines.

Colluvial: Soil material, rock fragments, or both, which have been deposited at the base of a steep slope by creep, slide, or local wash.

Comminute: To reduce to minute particles or pulverize.

Community: Any group of organisms belonging to a number of different species that co-occur in the same habitat or area and interact through trophic and spatial relationships, typically characterized by reference to one or more dominant species.

Critical Viewsheds: A unit within a National Wild River that has special considerations.

Crown Fire: A fire that burns mainly the top foliage of trees or shrubs.

Crustose: Having a thin thallus, adhering closely to a substratum of rock, bark, or soils.

Cryofibrist: An organic soil material (peat) formed under cold conditions.

Cryogenic: A soil formed under cold conditions, literally "cold genesis."

Cumulative Effects or Impacts: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

D2: Refers to Section 17(d)2 of the Alaska Native Claims Settlement Act.

Deciduous: To fall off or shed annually, seasonally, or at a certain stage in the life cycle.

Dendritic: A stream pattern characterized by irregular branching in all directions.

Detritus: Material released by weathering processes and subsequently transported and deposited as sediments.

Dike: A tabular igneous intrusion that cuts across the structure of the surrounding rock.

Disclimax: An ecological succession maintained below climax by climatic instability, fire, grazing, or by the activities of man.

Ecosystem: The Community including all the component organisms together with the abiotic environment, forming an interacting system, e.g., a marsh.

Ecotone: The boundary or transitional zone between adjacent communities or biomes.

Endangered species: Any species which is in danger of extinction throughout all or a significant portion of its range due to current or planned activity. (The Endangered Species Act - Amendments of 1982).

Endemic: Native to or restrictive towards a particular type of habitat, locality, or region.

Environmental Assessment: This document is prepared for actions not exempt from NEPA, not categorically excluded, not adequately covered in an existing RMP/EIS or other environmental analysis, and not normally or obviously requiring an EIS.

Ericaceous: Refers to the heath family of plants. Heaths are dwarf woody shrubs, including such species as blueberries, cranberries, mossberries, etc.

Federal Land Policy and Management Act (FLPMA): BLM's "organic act" which serves as the basic law providing direction for lands and minerals management under its jurisdiction.

Federal Register: A publication system used to inform the public of Federal regulations, proposed regulations, and to provide for the publication of agency statements of organization, procedural rules, and general policy.

Felsic: An igneous rock containing light minerals such as quartz, feldspars, feldspathoids and muscovite.

Fingerling: A fish up to one year of age; between the fry and smolt stage.

Fines: The smaller-grained particles of soil or gravel, usually consisting of fine sand, silt, and clay.

Flaggy: A soil characterized by coarse rock fragments that are flat, thin, and angular, with dimensions of six to 15 inches.

Flocculation: A chemical process that causes clay particles to stick together, making them settle out faster and reduce turbidity.

Fluvial: Produced by river or other stream action.

Foliose Lichens: Lichens having a flat, thin, and usually lobed thallos attached to a foundation.

Forb: Any herbaceous plant which is not a grass or sedge.

43 CFR 3809: Regulations which set forth policies and procedures providing for mineral entry, exploration, location, operations and purchase pursuant to the mining laws in a manner that will not unduly hinder such activities, but will assure that these activities are conducted in a manner that will prevent unnecessary or undue degradation and provide protection of non- mineral resources of the Federal lands.

404 Permit: The 404 guidelines are the substantive criteria used in evaluating discharge of dredged or fill material under Section 404 of the Clean Water Act.

Freshet: A great rise or overflowing of a stream due to heavy rains or melting snow.

Frost Boil: A small area of upward movement of soil or inorganic material caused by the freezing and thawing of free water in the soil.

Fruiticose: More or less shrub-like.

Fry: A recently hatched fish that has used up the yolk sac, and has emerged from gravel and is ready to feed.

Gel Log: A chemical treatment that settles out suspended solids from effluent water before releasing it into a stream.

General Mining Law of 1872: Provides for exploration, development, production, and purchase of mineral resources of the public lands, as well as the implied right of statutory access to mining claims.

Giardia: Infestation or disease caused by a flagellate protozoan.

Graminoid: Refers to an herb with long, narrow leaves, i.e., grasses and sedges.

Gravimetric: Analysis which pertains to a measurement by weight.

Harrow: A cultivating implement with spikes, spring teeth, or discs, and used primarily for smoothing and distributing soil.

Herb: A plant with one or more stems that die back to the ground each year; grasses and Forbs as distinct from shrubs and trees.

Hydrology: The study of the origin, distribution, and properties of water on or near the surface of the earth.

Hydrostatic Pressure: Pressure exerted or transmitted by fluids at rest.

Ice Wedge: Wedge-shaped ground ice produced in permafrost, occurring as a sheet, dike, or vein tapering downward. It originates as the growth of frost or by the freezing of water in a narrow crack or fissure.

Invasion: The Migration and Establishment of an organism in a new location.

Karst: An irregular limestone region with sinks, underground streams, and caverns.

Lacustrine: Pertaining to, produced by, or formed in a lake or lakes.

Legume: A plant belonging to the pea family (Leguminosae).

Listed Threatened and Endangered Species: A species (plant or animal) that is officially recognized by FWS as being threatened or endangered.

Lithic: A sedimentary rock containing abundant fragments of previously formed rocks; also said of such fragments.

Loam: Soil material that is seven to 27% clay particles, 26 to 50% percent silt particles and less than 52% percent sand particles.

Lode: A vein containing important quantities of metallic ore and filling a well-defined fissure in the rock.

Mafic: Igneous rock composed chiefly of one or more dark iron and magnesium-bearing minerals.

Management Framework Plan: A planning decision document prepared before the effective date of regulations implementing land use planning provisions of FLPMA which provides interim management until replaced by the RMP.

Massif: A principal mountain mass.

Management Goal: Goals that have been developed through the planning processes of BLM and other agencies for the watersheds being considered.

Master Title Plats: Maps displaying lands status of lands managed by the federal government.

Megafauna: Living or fossil animals large enough to be seen with the naked eye.

Metasedimentary: Sediment or sedimentary rock that shows evidence of being subjected to physical and chemical conditions below the earth's surface.

Mineral Soil: Soil composed mainly of inorganic materials and with only a relatively low amount of organic material.

Mining Technique: Methods used by miners to operate their mine. This includes activities such as exploration, access, development, mineral extraction, and reclamation.

Moraine: A mound, ridge or other distinct accumulation of glacial drift deposited chiefly by direct action of glacial ice.

Morphology: A branch of biology or paleontology that deals with the form and structure of animals and plants, or their fossil remains.

National Environmental Policy Act (NEPA): This Act establishes a national policy for the protection and enhancement of the environment. Federal agencies are directed to develop methods and procedures that ensure the unquantified environmental values are given appropriate consideration in decisionmaking as are economic and technical considerations.

National Recreation Area: A federally managed area which involves the protection, regulated use, and development of public lands for recreational enjoyment.

Native: Indigenous; living naturally within a given area; used of a plant species that occurs at least partly in natural habitats and is consistently associated with certain other species in these habitats.

Navigable Waters of the United States - (COE definition): Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity (33 CFR 329.4).

Non-Point Source: All turbidity, suspended sediment, and sedimentation resulting from soil erosion caused by human activity and emanating from a widespread area.

Notice: A Notice must be filed by all mining operators whose operations, including access across federal lands to their claim, cause a cumulative surface disturbance of five acres or less during any calendar year.

Notice of Intent: A public notice stating that an environmental impact statement will be prepared and considered.

Orographic: Relating to mountains, ie., precipitation caused by uplift of an air mass over a mountain range.

Oxbow Lakes: Remaining lakes that were once a part of a river channel, but are now isolated from the main stream. Most resemble a bent or U-shaped configuration.

Peltic: 1) Pertaining to or characteristic of pelite, a sedimentary rock composed of clay and minute particles of quartz. 2) A metamorphic rock derived from a pelite.

Physiography: Relating to the form of the earth or its surface features, e.g. topography.

Peraluminous: A type of igneous rock in which the molecular proportion of alumina exceeds that of soda, potash, and lime combined.

Performance Standards: A measurable quantity used to define the limits of allowable environmental impacts resulting from mining and related activities.

pH: The hydrogen-ion activity of a solution, which is an indication of the solution's acidity or basicity.

Physiography: Relating to the form of the earth or its surface features, e.g., topography.

Plan of Operations: This plan is required for mining operations disturbing five surface acres or more, and any operation except casual use in areas designated for potential addition to, or an actual part of the Wild and Scenic Rivers System, and designated areas of Critical Environment Concern, the National Wilderness Preservation System administered by BLM, and areas closed to off-road vehicle use.

Pluton: An igneous intrusion or rock mass formed within surrounding rock of another type.

Primary Succession: Succession beginning on a bare area, not previously occupied by plants or animals.

Propagule: Any part of an organism, produced sexually or asexually, that is capable of giving rise to a new individual.

Proposed Action: Any resource use or development or management action proposed by the Bureau, or to the Bureau by a member of the public, or by another agency through any appropriately developed procedures including, in the case of non-Bureau proposals, nominations, petitions, and applications.

Record of Decision: A brief statement which completes the associated EIS and, among other things, indicates which alternative, or combination of alternatives has been approved.

Recorded: The filing of paperwork with the State and BLM to make a mining claim properly of record.

Resource Management Plan: A land use plan as prescribed by the Federal Land Policy and Management Act which establishes: 1) the level and intensity of land use, 2) allowable resource uses and related levels of production or use, 3) resource condition goals and objectives, 4) program constraints and general management practices needed to achieve the above, 5) the need for an area to be covered by more detailed and specific plans, 6) support action to achieve the above, 7) general implementation sequences, and 8) intervals and standards for monitoring and evaluating the plan. It is not a final implementation decision on actions which require further specific plans, process steps, or decisions under specific provisions of law and regulations.

Riparian: Refers to land bordering a stream, lake, or tidewater.

Scarify: See harrow or chaining.

Scoping: The act of holding organized meetings to address significant issues that are of particular concern to individuals or groups.

Section 810: Section within ANILCA mandating that subsistence uses and needs are to be considered in federal land use decisions.

Sedge: A rush-like or grass-like plant that grows in wet places.

Sere: The series of stages that follow one another in an ecologic succession.

Serotinous: Refers to late opening, such as cones of black spruce trees which remain on the trees for several years without opening. Allows cones to survive fires, and provide seed source after fire.

Settling Pond: A pond, usually artificially constructed of tailings, designed to remove sediment from water by simple settling.

Settleable Solids: The volume of matter in water that will settle in one hour under quiescent conditions in an Imhoff cone.

Sierra Club Lawsuit: The series of orders and injunctions arising from the Sierra Club's action that resulted in this EIS.

Significance: A high degree of importance as indicated by either quantitative measurements or qualitative judgments. Significant issues and impacts require explicit consideration in preparing a plan. Significance may be determined by evaluating characteristics pertaining to location, extent, consequences, and duration. As used in the National Environmental Policy Act, "significance" requires consideration of both context and intensity. (see 40 CFR 1508.17)

Significant Restriction to Subsistence Uses and Needs: BLM policy states that a "significant restriction to subsistence uses and needs" could occur if there is: 1) a reduction in harvestable resources used for subsistence purposes, 2) there is a reduction in the availability of resources caused by an alteration in their distribution, migration, or location, or 3) a limitation on the access of subsistence users to harvestable resources. Generally, only the prediction of large or substantial effects as opposed to slight effects in one or more of these three categories would result in a section 810 evaluation of significant restriction to subsistence uses and needs.

Sill: A tabular igneous intrusion that parallels the structure of the surrounding rock.

Silt: Sediment particles between 0.004 and 0.0625 mm in equivalent spherical diameter.

Skarn: An old Swedish mining term for silicate waste rock with certain iron-ore and sulfide deposits.

Sluice: To mine or wash with water. Also used synonomously with sluicebox.

Sluicebox: The rectangular shaped launder, containing riffles, that is used as a gold recovery system in placer mining.

Solifluction Lobe: A mass of soil material which, because of water saturation, has formed a small terrace through the slow, mass movement of the soil blanket downslope.

Special Area: Those geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important or easily disrupted ecological values.

Stock: An igneous intrusion that is smaller than a batholith and more or less circular in shape.

Stone Stripe: A form of patterned ground consisting of a line of rocks or other inorganic material parallel to the slope of the ground, caused by the freeze - thaw cycle and the effects of gravity.

Stratigraphy: The science of the arrangement of rock strata.

Stream Bypass: A channel constructed to divert an active stream channel around a mining operation, so to avoid direct stream contact.

Strike-slip Fault: A fault on which the movement is parallel to the fault's strike.

Subsistence Uses: Section 803 of ANILCA defines the term "subsistence uses" to mean "...the customary and traditional uses by rural Alaskan residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade." For the purposes of this definition, 1) "family" means all persons related by blood, marriage, or adoption, or any person living within the household on a permanent basis; and 2) "barter" means the exchange of fish or wildlife or their parts, taken for subsistence uses - (a) for other fish or game or their parts; or (b) for other food or for nonedible items other than money if the exchange is of a limited and noncommercial nature.

Succession: The replacement of one kind of community by another kind; the progressive changes in vegetation and in animal life which may culminate in the climax.

Sucker: In many plants, a shoot arising from the lower parts of the stem or from the root.

Suite: A collection of rock specimens from a single area, generally representing related igneous rocks.

Taiga: A swampy area of coniferous forest.

Tailings: Waste material processed through a placer operation usually consisting of coarse sand and larger particles.

Taxonomic: The study of the general principles of orderly scientific classification, usually according to their presumed natural characteristics.

Terrane: A rock or group of rocks and the area in which they crop out.

Threatened Species: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (The Endangered Species Act - Amendments of 1982).

Thrust Fault: A fault with a dip of 45° or less over much of its extent, on which the hanging wall appears to have moved upward relative to the footwall. Horizontal compression rather than vertical displacement is its characteristic feature.

Tiering: An interrelationship in which reference to a more general NEPA document such as an EIS can be made by a more specific one, thus avoiding duplication. Designed to focus on the actual issues ripe for decision at each level of environmental review.

Topsoil: The upper soil layer or layers containing some organic matter.

Tailrace: A channel in which mine tailings are carried away.

Tundra: The treeless land in arctic and alpine regions, varying from bare area to various types of vegetation consisting of grasses, sedges, forbs, dwarf shrubs, mosses, and lichens.

Turbidity: The condition of a body of water that contains suspended material such as clay or silt particles, dead organisms or their parts, or small living plants and animals.

Tussock: A dense, heavy tuft or matted growth of grass or sedge which forms a small hillock.

Type: A kind of vegetation, e.g., community-type, forest type, birch type.

Unnecessary or Undue Degradation: This is surface disturbance greater than what would normally result under a prudent operator in usual, customary, and proficient operations of similar character. Effects of operations on other resources and land uses, including resources and uses outside the area of operations are also considered.

Vegetation Type: A kind of vegetation or the kind of community of any size, rank, or stage of succession.

Vegetative Reproduction: Reproduction by asexual processes.

Visual Resource Management (VRM): Utilized to classify landscapes and visual characteristics. Classification I has a higher value than II and III.

Volatile Organics: Carbon-based matter that is highly vulnerable to disruption.

Watershed: A region or area bounded peripherally by water. parting and draining ultimately to a particular watercourse or body of water.

Wetland: 1) An area of low-lying land, submerged or inundated periodically by fresh or saline water. 2) Wetlands have been defined by the COE in 33 CFR 323 as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wild River: Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive, and waters unpolluted.

Windlass: A device for hauling or hoisting.

Zero Discharge: A condition where there is no effluent discharge from a mining operation.

Acronyms

ACEC........Area of Critical Environmental Concern

ADGGS.....Alaska Department of Geological and Geophysical Surveys

ADFG........Alaska Department of Fish and Game

ADNR........Alaska Department of Natural Resources

AHC...........Arctic Hydrologic Consultants

AHRS........Alaska Heritage Resources Survey

ANILCA....Alaska National Interest Lands Conservation Act

APMA........Annual Placer Mining Application

BLM..........Bureau of Land Management

CEQ..........Council on Environmental Quality

CFR...........Code of Federal Regulations

CFS...........Cubic Feet per Second

COE..........Corps of Engineers

DEC..........Department of Environmental Conservation (Alaska)

DOA..........Department of Agriculture

DOI............Department of Interior

EIS.............Environmental Impact Statement

EPA...........Environmental Protection Agency

FLPMA......Federal Land Policy and Management Act

ml/l...........Milliliters per liter

NEPA........National Environmental Policy Act

NOI............Notice of Intent

NPDES.......National Pollutant Discharge Elimination System

NTU............Nephelometric Turbidity Units

NWR...........National Wild River

RMIS...........Recreation Management Information System

RMP............Resource Management Plan

ROD............Record of Decision

SHPO.........State Historic Preservation Officer

SNCA.........Steese National Conservation Area

SRMS.........Special Recreation Management Area

TSS............Total Suspended Solids

U.S.C..........United States Code

USGS..........United States Geological Survey

VRM...........Visual Resource Management

WMNRA.....White Mountains National Recreation Area

WRC...........Water Resources Council

WRM..........Wild River Mile

WSRA........Wild Scenic River Act

YOY...........Young of Year

R'S CARD

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